UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

SNAP4CITY

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Digitale, Servizi locali e Smart Cities

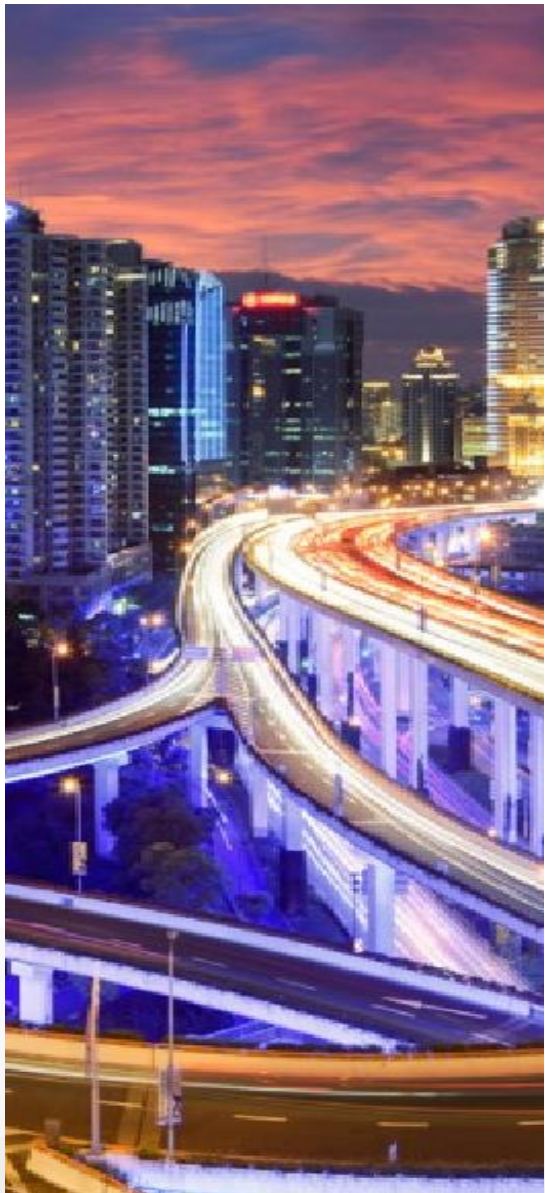
Paolo Nesi, paolo.nesi@unifi.it
https://www.snap4city.org
https://www.disit.org

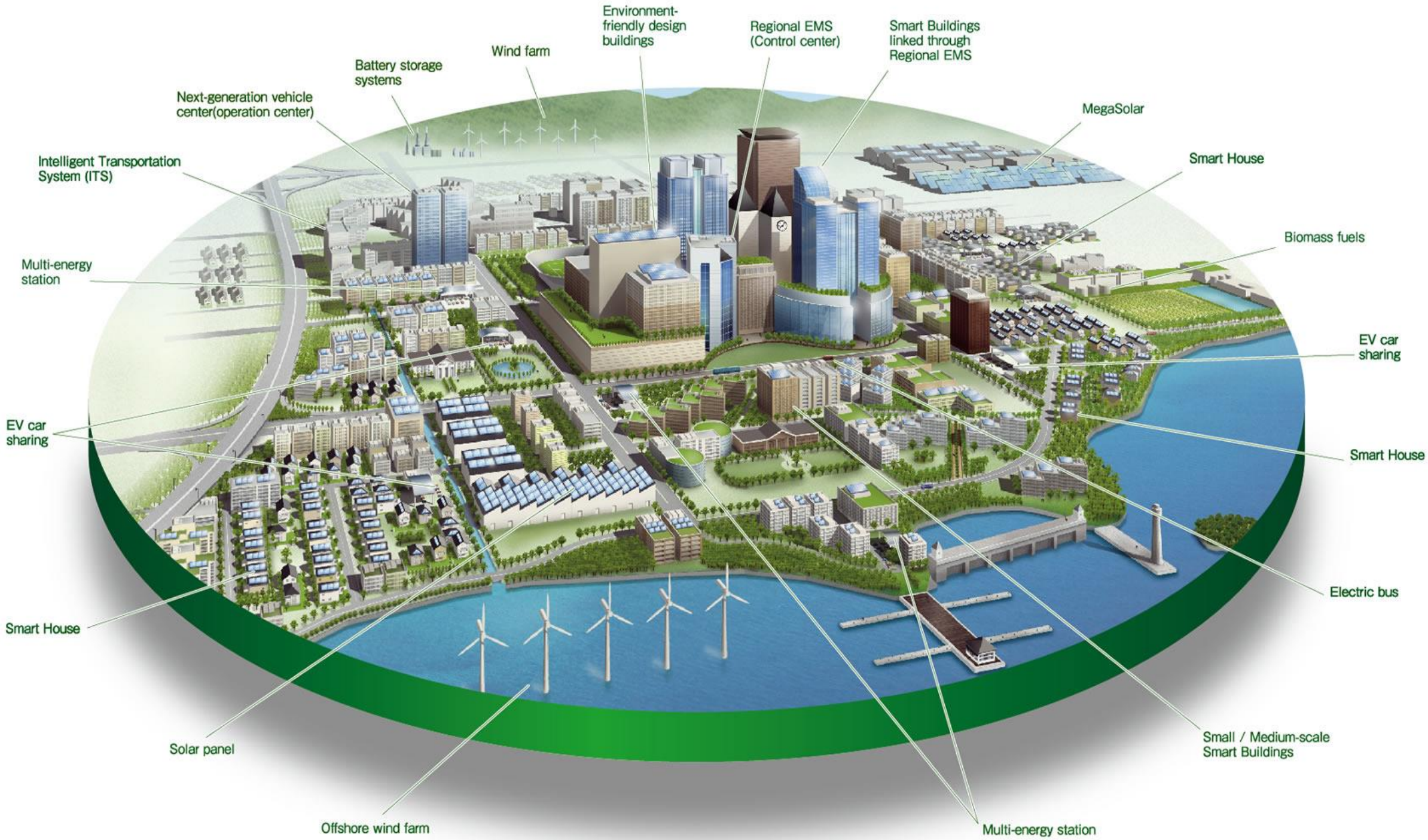
eunomia

EUNOMIAMASTER
ALTA FORMAZIONE POLITICO-ISTITUZIONALE

Motivations of the Smart City

- Migration towards cities: in the 2050 more than the 75% of population will live in the cities.
  - More opportunities, higher salaries, etc.
- Cities have to cope with the increment of citizens providing higher quality of services & efficiency:
  - To this end, they have to conquer a high level of
    - control on: expenses, quality of services,….
    - quality of services, new services, etc.
    - sustainability of services …




Environment-friendly design buildings
Regional EMS (Control center)
Smart Buildings linked through Regional EMS
Wind farm
Battery storage systems
Next-generation vehicle center(operation center)
MegaSolar
Intelligent Transportation System (ITS)
Smart House
Biomass fuels
Multi-energy station
EV car sharing
EV car sharing
Smart House
Electric bus
Smart House
Small / Medium-scale Smart Buildings
Solar panel
Offshore wind farm
Multi-energy station

Smart City Domains

- Health
- Education
- Economy & commercial
- Energy
- Environment
- Mobility & Transport
- People & Living
- Governmental
  - Risk management, Resilience
- …






Sustainability of the Growth

- To be **planned and managed** with respect to increment of population and their needs
  - Increment of quality of life, more services or more efficient services
  - provisioning of new services in place of older services
  - Decision support for strategic aspects:
    - Corrections, prediction, new services, etc.
- **Towards citizens**
  - Informing citizens on the new adaptations, making them aware about that
  - Forming citizens to adopt virtuous behaviour in the usage of services and resources
  - Collecting their feedback continuosly via a multichannel

Challenges: Requests and Deductions

Public Admin.

Pub. Admin: detection of critical conditions, improving services

Mobility Operators

Tune the service, reselling data and services , prediction

Commercial: customers prediction and profiles, promotions via ads

Tourism Museums

Tune the service, prediction

API for SME

Smart City Engine

User profiling
Collective profiles
User segmentation

Services & Suggestions
Transport, Mobility, Commercial (retail), Tourism, Cultural

Personal Time Assistant
dynamic ticketing, whispers to save time and money, geoloc information, offers, etc.

User Behavior
Crowd Sources

Data: Public and Private, Static and Real Time

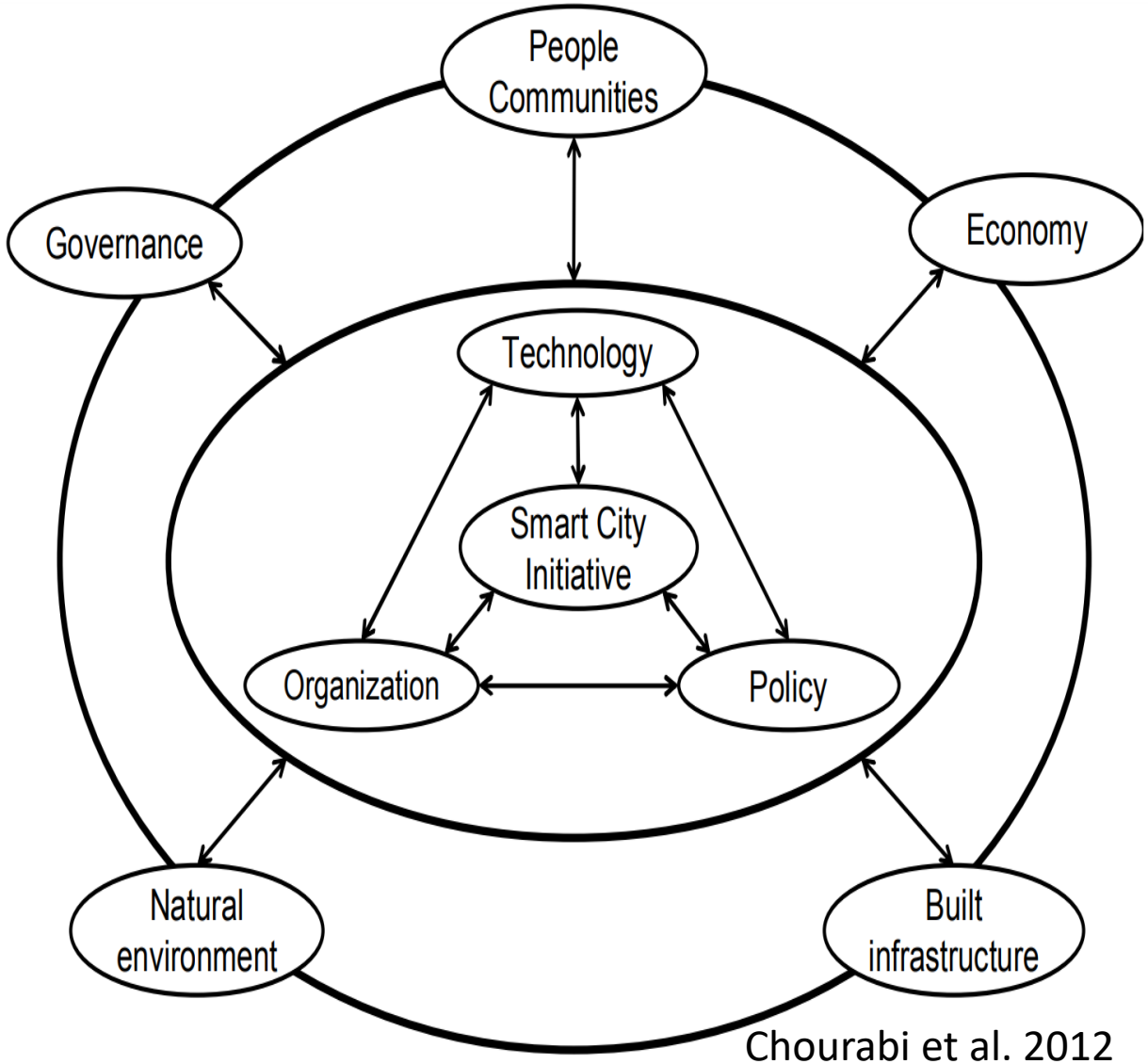
Private: user movements, social media, crowd sources, commercial (retail)
Public: infomobility, traffic flow, TV cameras, flows, ambient, weather, statistic, accesses to LTZ, services, museums, point of interests, …

Smart City Process

- Many aspects should be taken into account for a successful Smart City transformation

- → *The influence of each of them depends on context, attitude of the institutions, internal structure, etc.*
  - *Parallel actions can conflict, compete …*
  - *Spreading of efforts may distance the goals*
  - *……*

- → *The process may become sustainable, harmonized and faster with a Living Lab Strategy and Support*



Chourabi et al. 2012

Snap4City has been Created to satisfy requirements of:

European Network of Living Labs

- **ENOLL**: https://www.openlivinglabs.eu/
  - European Network of Living Labs

EIP-SCC

- **EIP-SCC**: European Innovation Partnership on Smart Cities and Communities
  - https://eu-smartcities.eu/

SELECT for Cities

- **Select4Cities**: Pre-Commercial Procurement Project to develop a data-driven, Internet-of-Everything (IoE) platform for large-scale urban co-creation
  - https://www.select4cities.eu/

Data Driven Decision Support

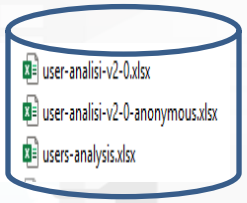
- Decision Support system
- Assessment / Strategies
- Data Rendering, visual analytics
- Data Processing
- Data aggregation, Storage, indexing
- Data Ingestion

Data Collection, ingestion (processes)

- **Data**
  - Open and private: Open Data: CKAN
    - licensing, private, GDPR
  - Static vs Real time
  - Any protocol, any standard: Push and Pull
  - Any format
- From **observations and milestones**:
  - sensors, database, KPI, etc.
- From **legacy services** of in-place operators
  - External Services: call of any kind
  - MicroServices, MicroApplications
  - Local databases
- From **citizens, city users, tourists, operators, ..**:
  - participated processes, feedback, Apps, etc.
  - Crawling web pages, etc.

IOT Device

ckan



Private and static

- Fiscal Code, SSN
- Non shared pictures
- Level aspects
- Patient health record
- ..

- Personal movements
- GPS traces
- Relationships among people

- User Behaviour
- social media
- Contributions
- Consumption of energy, gas
- banking

Static Public (open data)

statistics: accidents, census, votations

- # Accesses to RTZ ZTL
- Data from Public GOV

- Position of commercial activities, POI

- Museums
- City services data, almost
- Active services

- TV cameras

- Personal traffic
- Position of cars
- Position of taxi
- Position of CarSharing ...

Real time private

- Info traffico
- video camere
- Info weather
- Info environment
- Status of the queue at Museums
- earthquake data
- parking

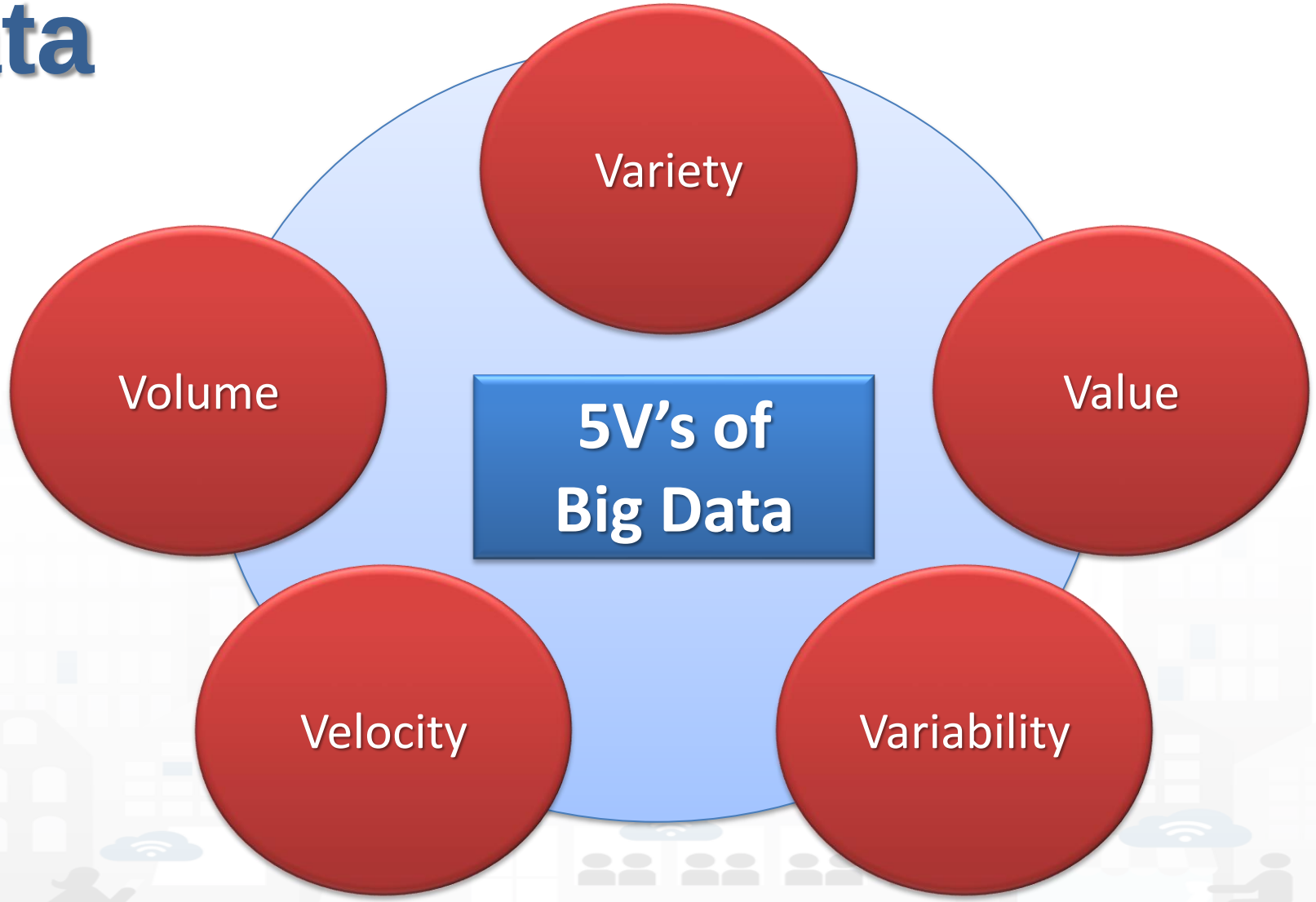
- Stato accessi alla ZTL
- Stato dei servizi

Real time public (open data)

5V of Big Data

When data are BIG data?

The excel file size?



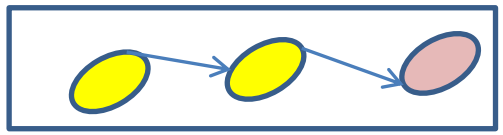
Other Vs have been also proposed…

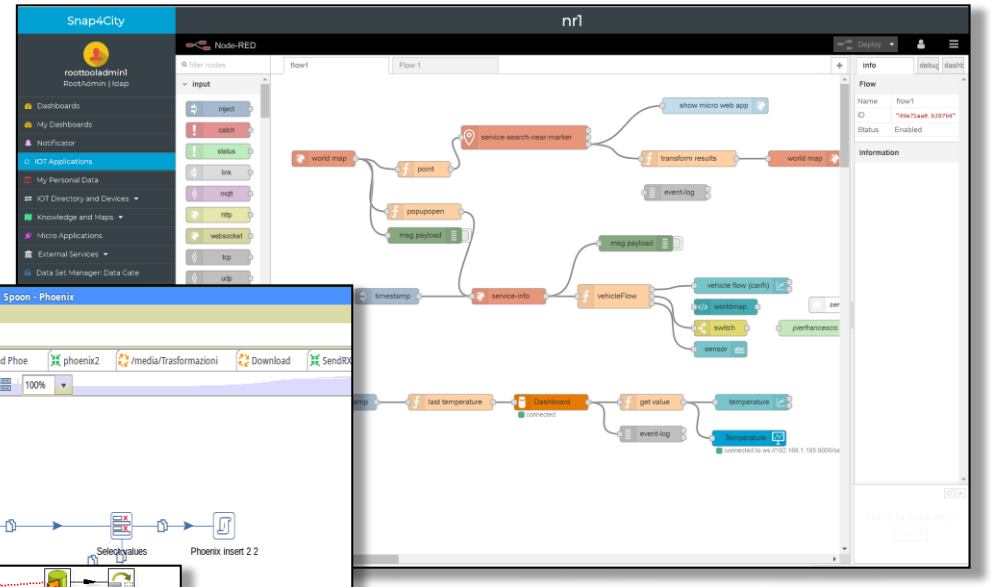
Integrated Urban Platform

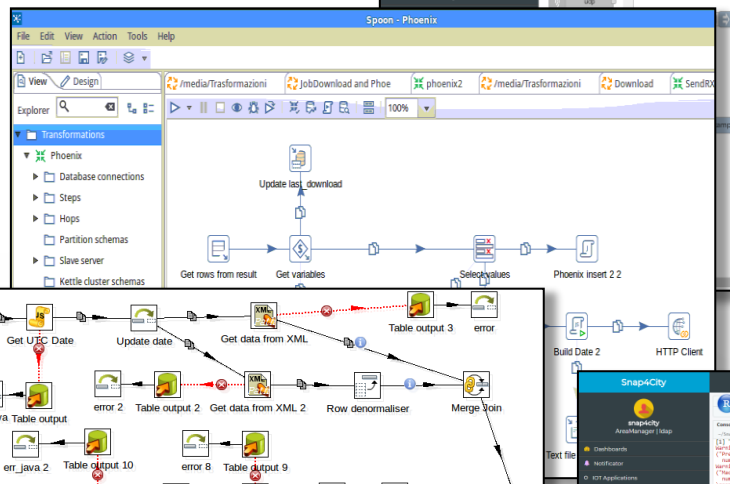
- **Produce value from data supporting Living lab**
  - Stimulate virtuous behavior, influence City Users!
  - Put in action CITY Strategies
- **Data Exploitation performing**
  - predictions, reasoning, business intelligence, ..
  - users behavior analysis, decision support system, ..
  - Control Room, Real Time Monitoring tools, ….
- **Aggregate & integrate data**
  - Multiple protocols from urban operators, ….
  - open data, IOT, sensors, internet of everything, cloud, mobile devices, Wi-Fi, social media, ...

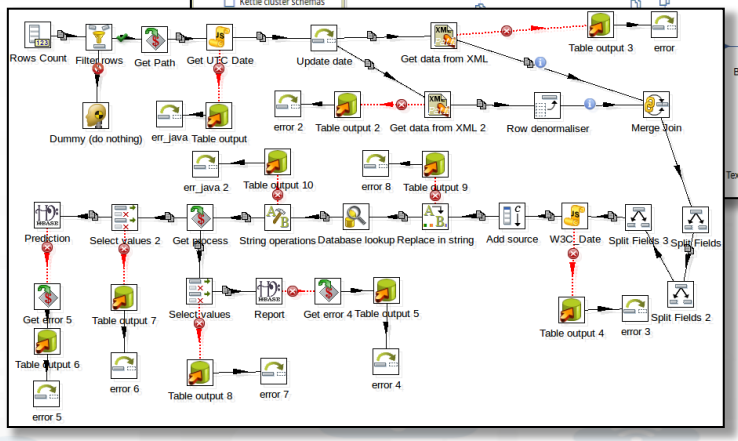
Data processing

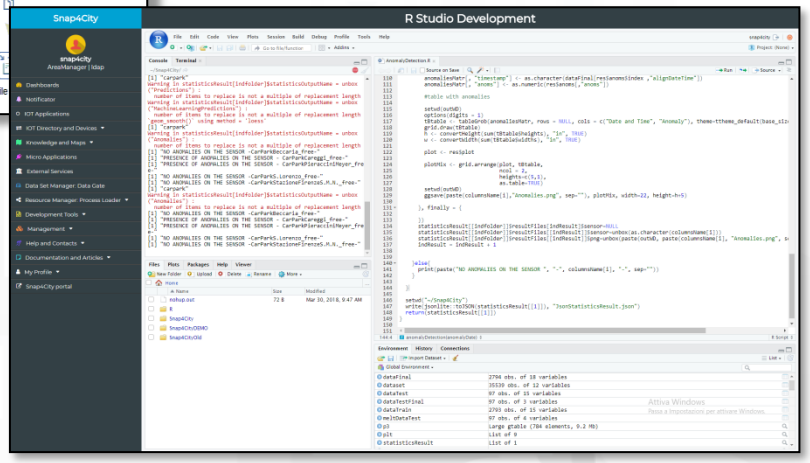
- **Data analytics**
  - Periodic or event driven
    - On demand
  - Data transformation
    - ETL: extract transform load
  - Control Flow, data transform
    - Node-RED: Node.JS
- **For example**:
  - Assessment/monitoring
  - Predictions
  - Anomaly detection
  - Simulations
  - Etc.





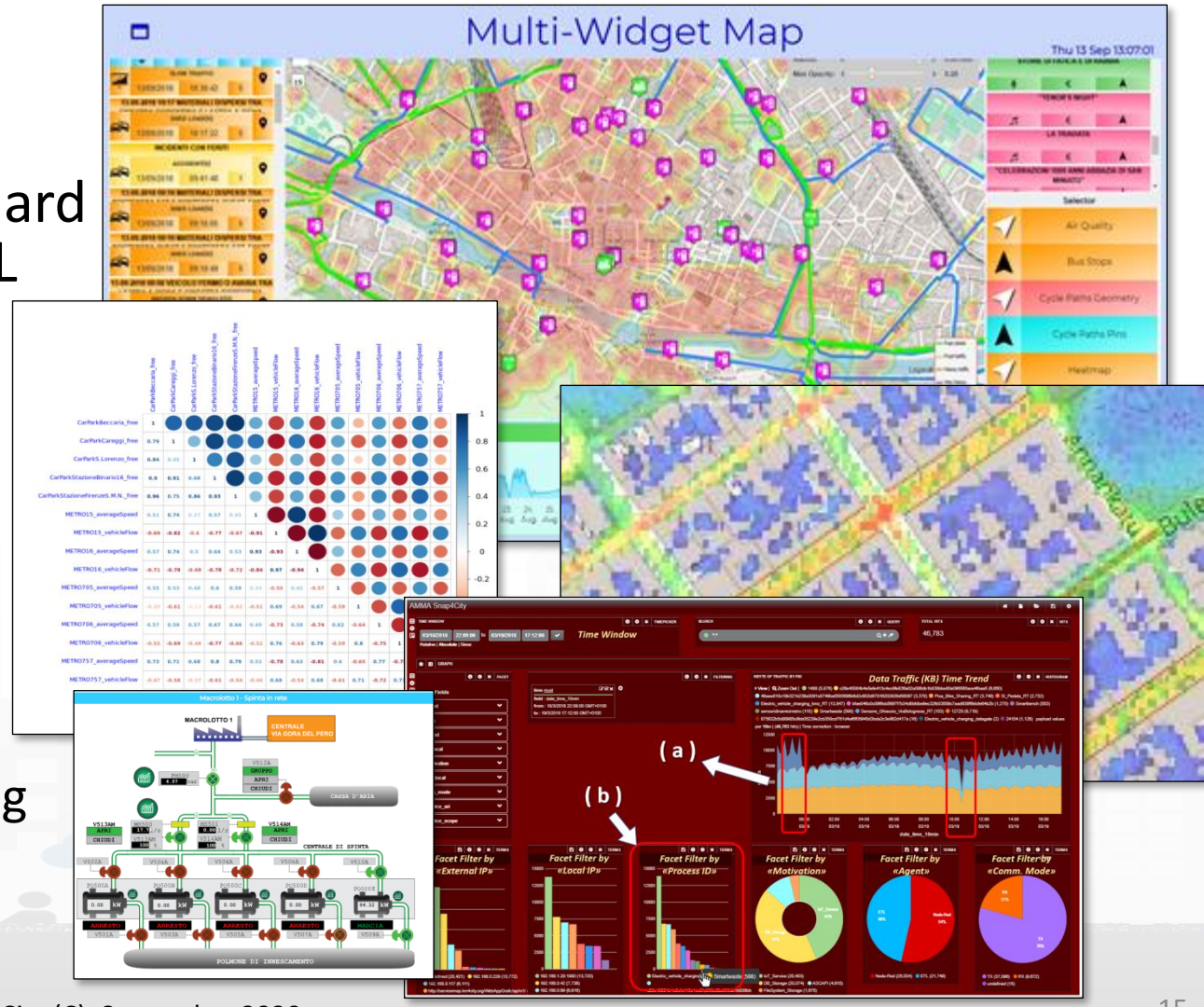






Data Rendering vs Control Room Dashboards

- **GIS** rendering by layers
- **Business intelligence** mainly focused on making statistics from tabular: no layer, hard relationships, ... Exploit Data Analytic, ETL
- **Visual Analytics**, data understanding
  - Rendering and drill down
  - Faceting/grouping (Elastic Search/SOLR)
  - Cross filtering (Kibana, Grafana, Banana)
  - Interactive, Cross Widgeting
- **Control Room Dashboards:**
  - Need: Visual Analytics, Data Analytic, geospatial reasoning, data driven processing
  - H24, alerting, Flexible rendering, custom widgets, interactive dashboards

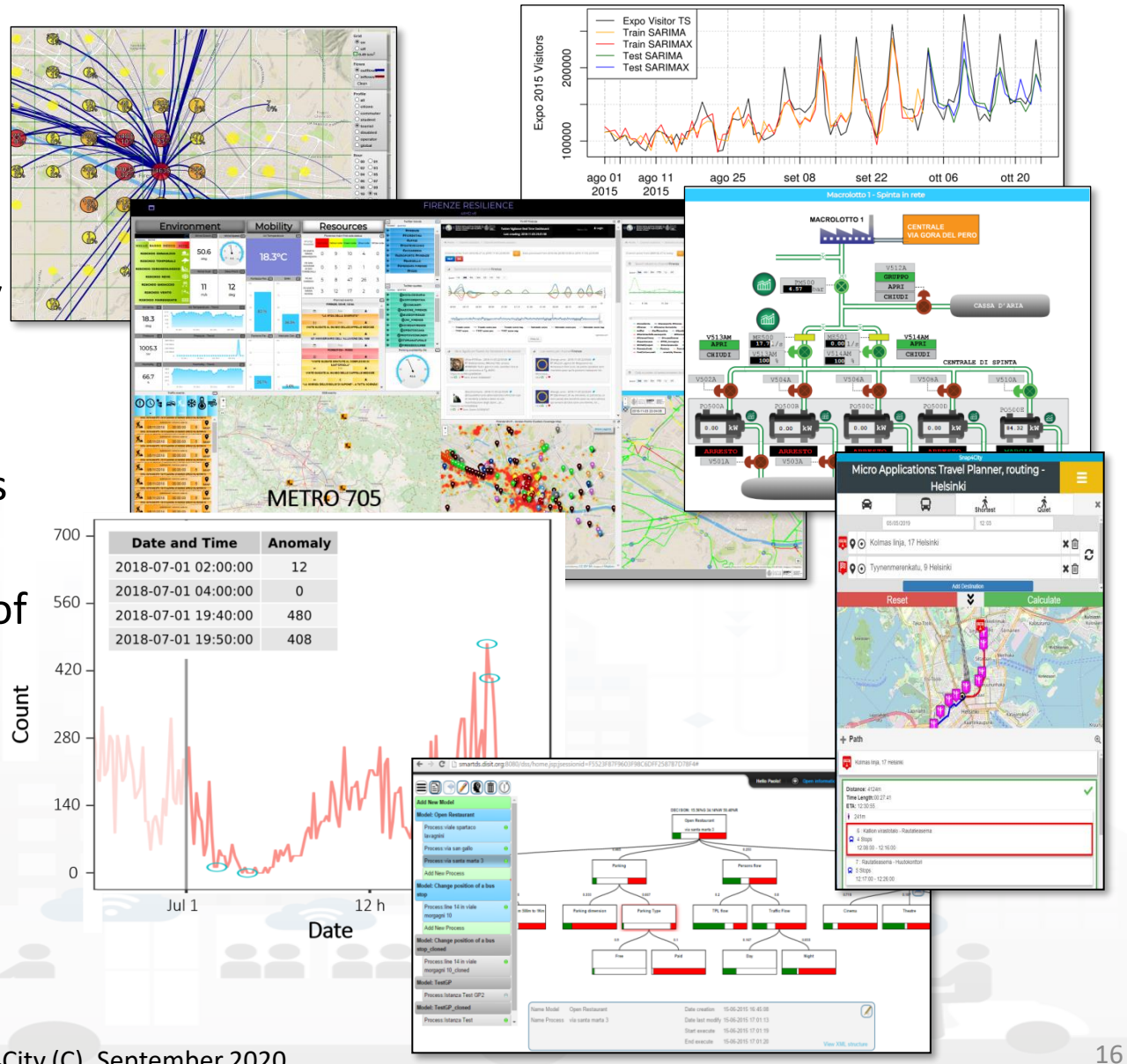


Decision Support, Act!

Smart City Control Room, SCCR, SCR

- Not only a collection of verticals

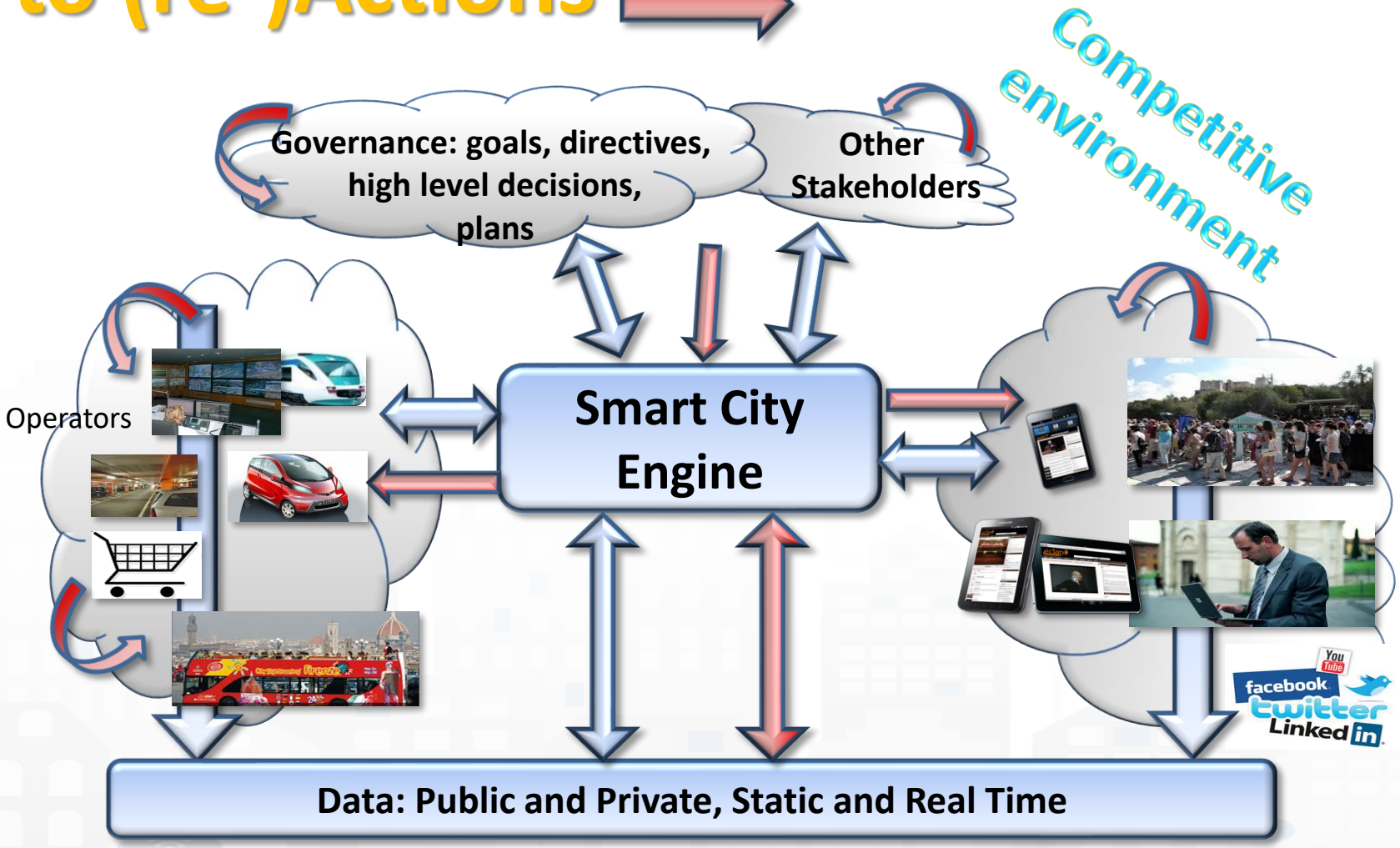
- **Exploiting analytics**: prediction, simulations, anomaly detection. ..
  - Big data approach to Data Analytics
- **Connecting Heterogeneous data** to defined strategies and alerting
- **Connected interactive dashboards** for different kind of decision makers: operators and majors
- **What-if Analysis taking into account multiple data sources**



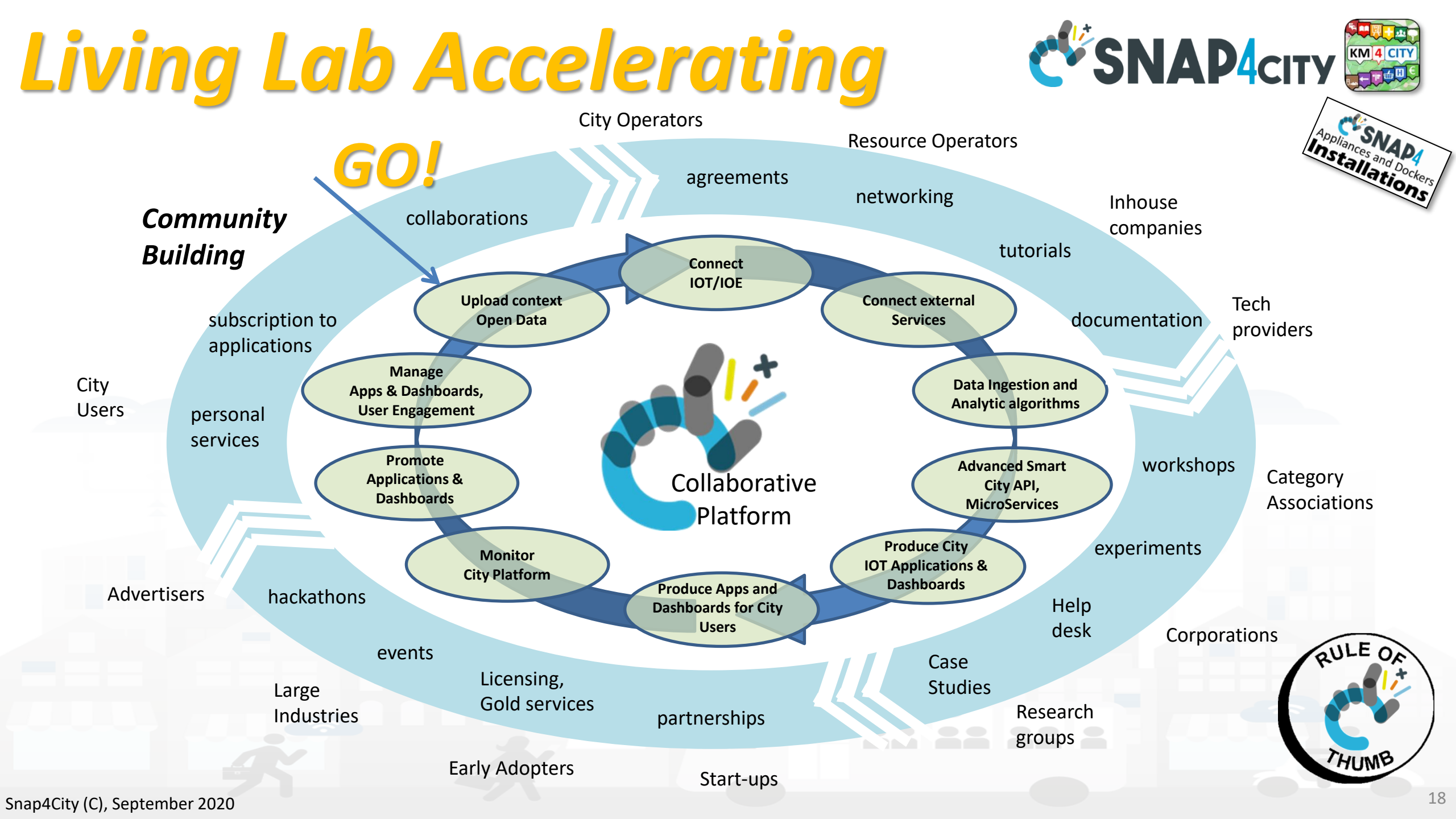
From strategies to Actions

From Strategies to (re-)Actions

- Informing
- Suggesting
- Engaging
- Alerting, Early Warning
- Making Decision active
- New Plan



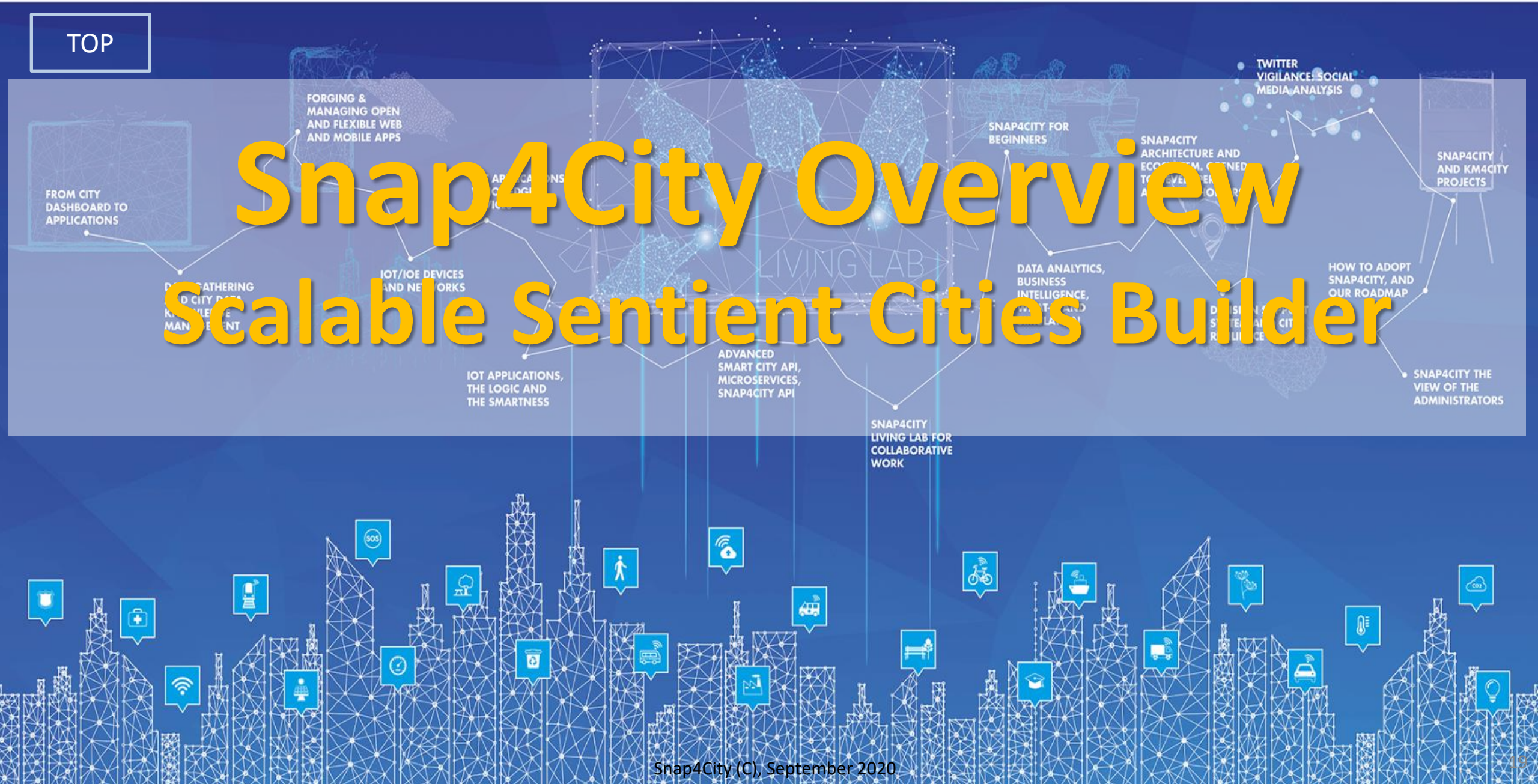
Living Lab Accelerating



TOP

Snap4City Overview

Scalable Sentient Cities Builder



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SNAP4CITY
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KM 4 CITY

Powered by FIWARE

SNAP4 Appliances and Dockers Installations

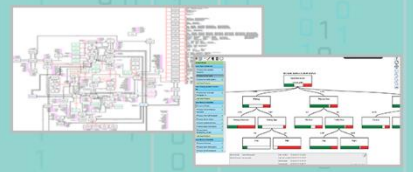
FREE TRIAL

PEN Test Passed

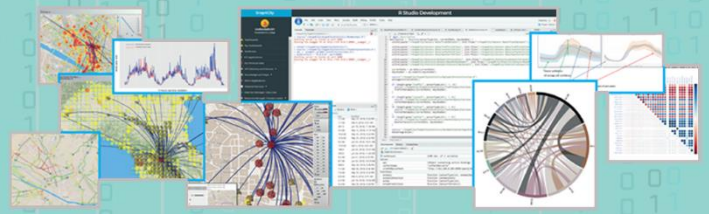
EU GDPR COMPLIANT

100% OPEN SOURCE

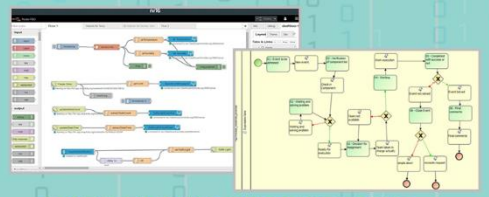
DASHBOARDS AND APPS - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS



EXPERT SYSTEM
KNOWLEDGE BASE
STORAGE

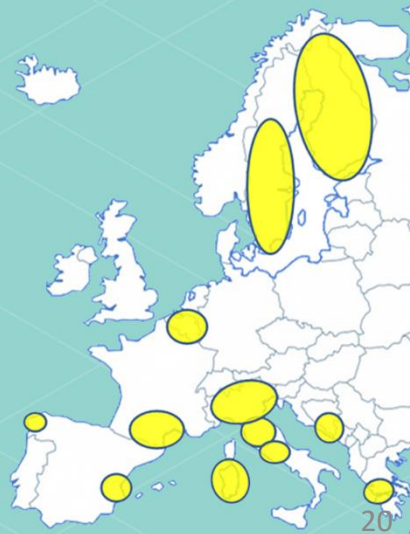


BIG DATA ANALYTICS
ARTIFICIAL INTELLIGENCE
BUSINESS INTELLIGENCE
MACHINE LEARNING



DATA FLOWS, WORKFLOWS
MICROSERVICES
MANAGEMENT

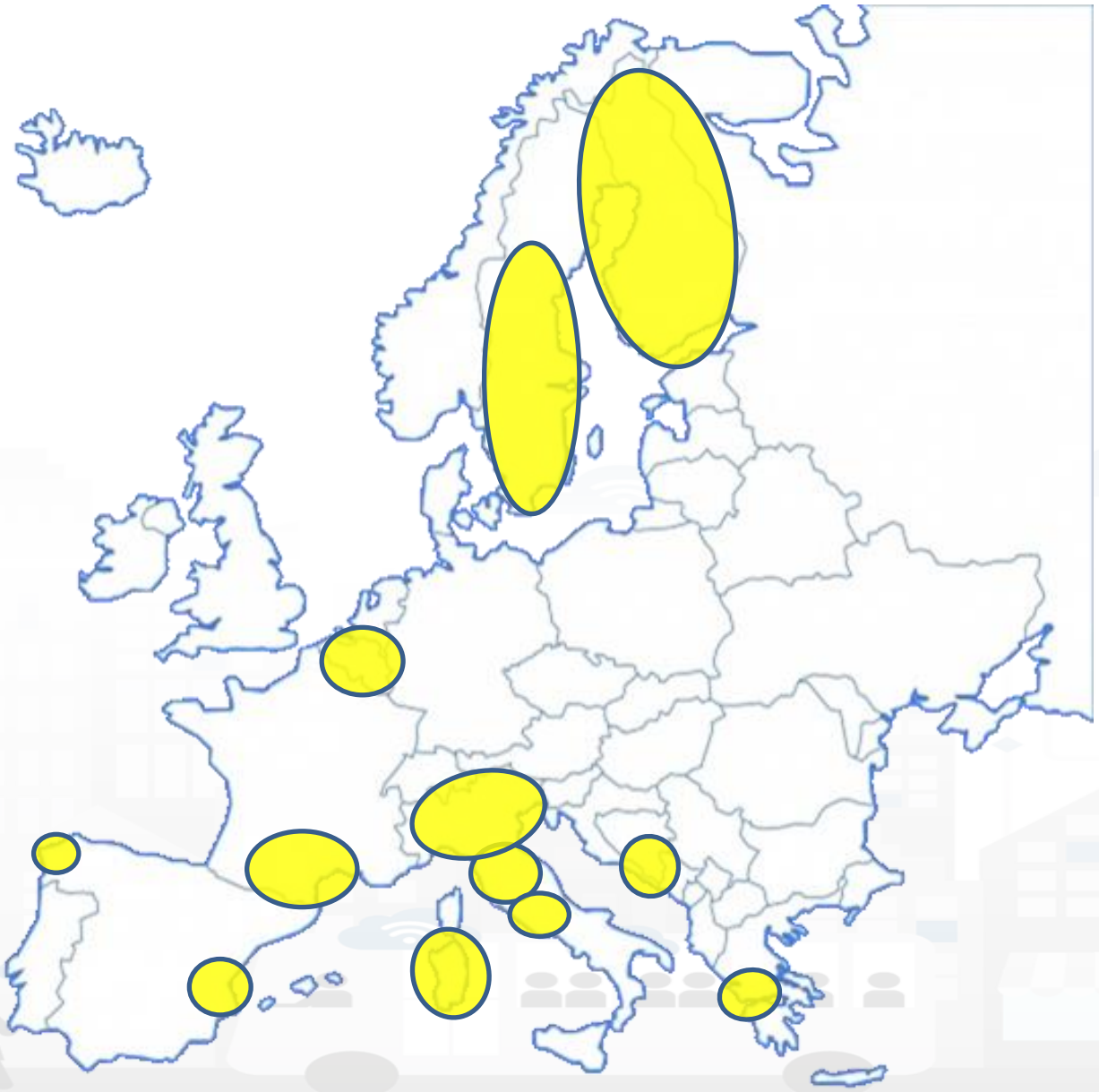
METHODOLOGIES
COURSES AND COMMUNITY
LIVING LABS
DEVELOPMENT TOOLS



Coverage 2020

Main Organizations/areas

- Antwerp area (Be)
- Capelon (Sweden: Västerås, Eskilstuna, Karlstad)
- DISIT demo (multiple)
- Dubrovnik, Croatia
- Firenze area (I)
- Garda Lake area (I)
- Helsinki area (Fin)
- Livorno area (I)
- Lonato del Garda (I)
- Modena (I)
- Mostar, Bosnia-Herzegovina
- Pisa area (I)
- Pont du Gard, Occitanie (Fr)
- Roma (I)
- Santiago de Compostela (S)
- Sardegna Region (I)
- SmartBed (multiple)
- Toscana Region (I), SM
- Valencia (S)
- Venezia area (I)
- WestGreece area (Gr)



Florence

http://www.darionardella.it/il-sindaco-dario-nardella-in-missione-a-madrid-e-barcellona/

Firenze Oggi 2019

Fri 25 Oct 23:29:38

43666
Totale utenti WIFI

COLONNINE RICARICA<...
176 INSTALLATE
71 % ATTIVE
5.1 % IN USO

GENERAL | METEO

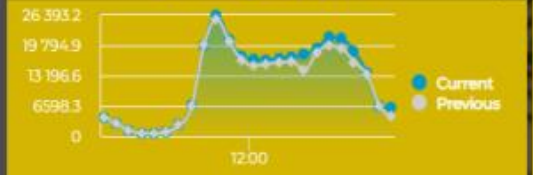
MINIMO	BASSO	MEDIO	ALTO

RISCHIO IDRAULICO
RISCHIO TEMPORALI
RISCHIO IDROGEOLOGICO
RISCHIO NEVE
RISCHIO GHIACCIO
RISCHIO VENTO

SITUAZIONE VIABILITA
0 INCIDENTI
0 CHIUSURE AL TRAFFICO (TOT)
0 CHIUSURE PER CANTIERI
0 PROGR. | 0 NON PROG.
0 LIMITAZIONI AL TRAFFICO (TOT)
0 LIMITAZIONI PER CANTIERI
0 NON PROG. | 0 PROGR.
0 TOT. EVENTI SULLA RETE

SMN	BINARIO16	FORTEZZA
28.7 % occupati su 607 posti	55.2 % occupati su 165 posti	27.8 % occupati su 521 posti
LEOPOLDA	**CALZA**	**S.AMBROGIO**
36 % occupati su 300 posti	70.3 % occupati su 148	99.7 % occupati su 379 posti
PARTERRE	**CAREGGI**	**BECCARIA**
34 % occupati su 656 posti	24.9 % occupati su 406 posti	98.1 % occupati su 210 posti

ANALYSIS
Energy | Environment | Mobility | Social | Resilience

FLUSSI INGRESSO CITTA


TOTALE
284094
VEICOLI

FLUSSI INGRESSO ZTL


TOTALE ZTL
57499
VEICOLI

Nati Italiani	Nati stranieri	Deceduti	Matrimoni	Unioni Civili
163 ultimo mese consolidato	49 ultimo mese	395 ultimo mese	19 ultimi 7 giorni	0 ultimi 7 giorni

Segnalazioni ricevute in attesa	In Lavorazione	Risolte	Chiuse senza risoluzion...
1116 ultimo mese	524	305	285

Manutenzioni Stradali	Verde Pubbli...	Decoro Urbano	Relitti
54 oggi	4	6	3

Attesa media alla fermata

Linea 6	Linea 13
3 min	13 min
Linea 17	**Linea 23**
4 min	5 min
Linea 31	**Linea 36**
19 min	2 min

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQzOA==

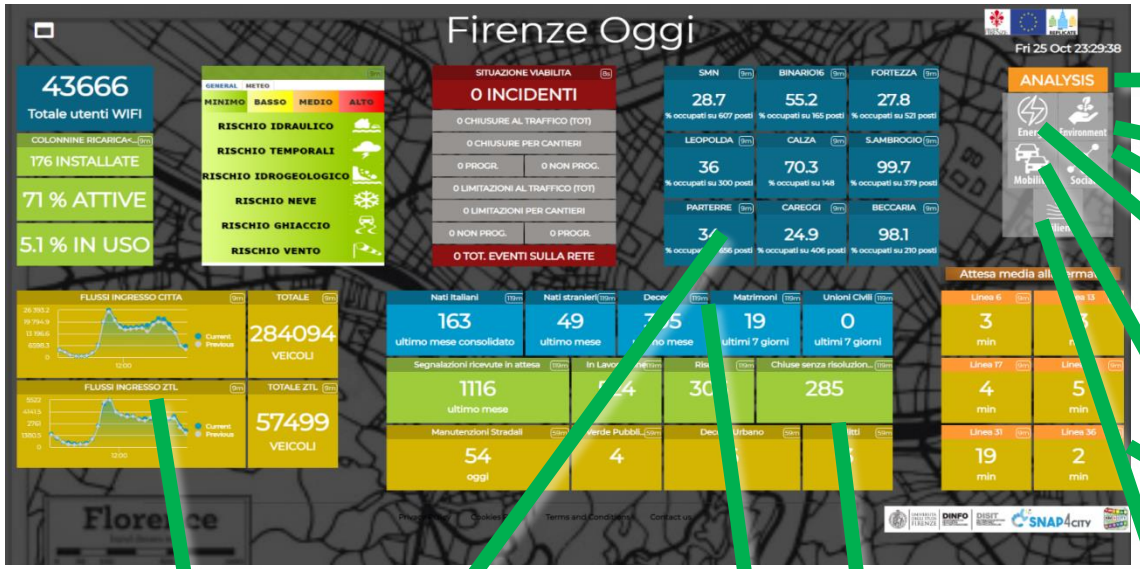
Smart City Control Room

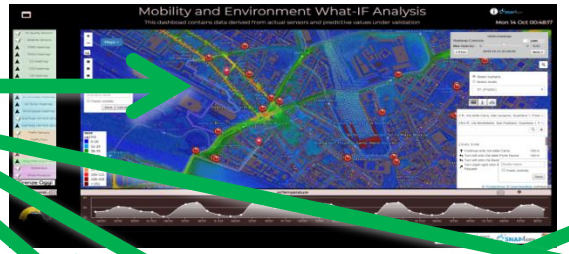
a set of dashboards and tools

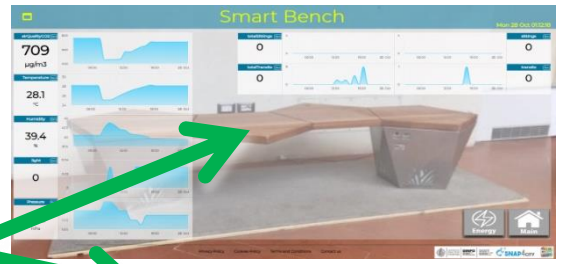
REPLICATE

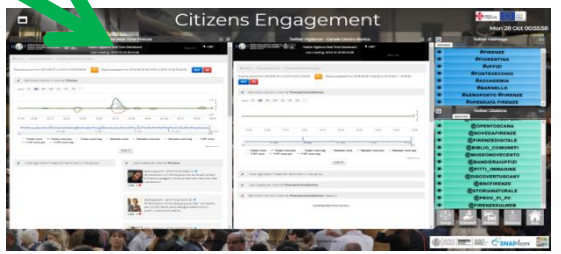
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement Nº 691735

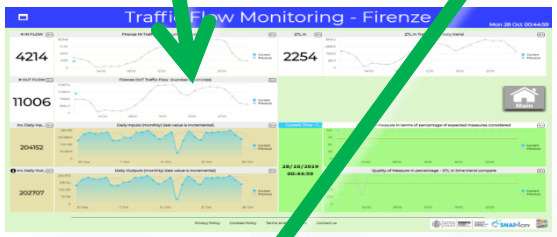
FIRENZE CITTÀ FARO

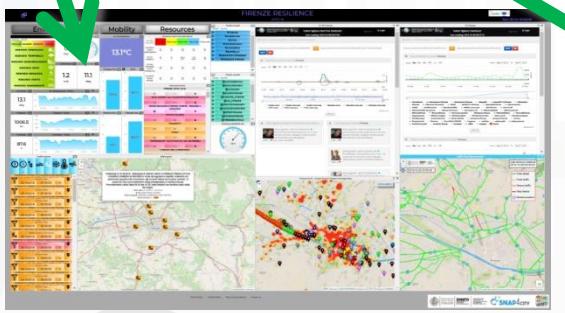


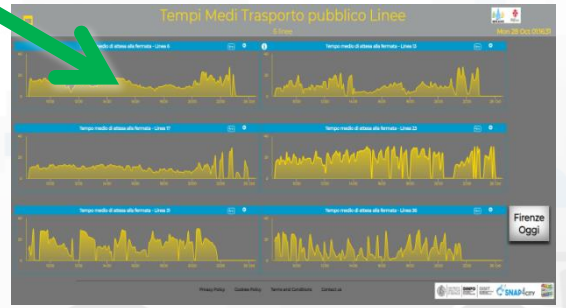












Mobility and Environment What-IF Analysis

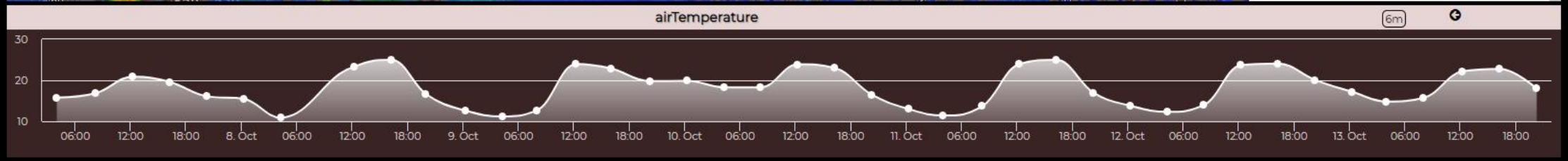
This dashboad contains data derived from actual sensors and predictive values under validation

Mon 14 Oct 00:48:17

- Air Quality Sensors
- Weather Sensors
- PM10 Heatmap
- PM2.5 Heatmap
- CO Heatmap
- CO2 Heatmap
- O3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow
- Cycling Paths
- Accident Heatmap
- Only HRes Anym. Gral
- Scenarious
- What-if analysis

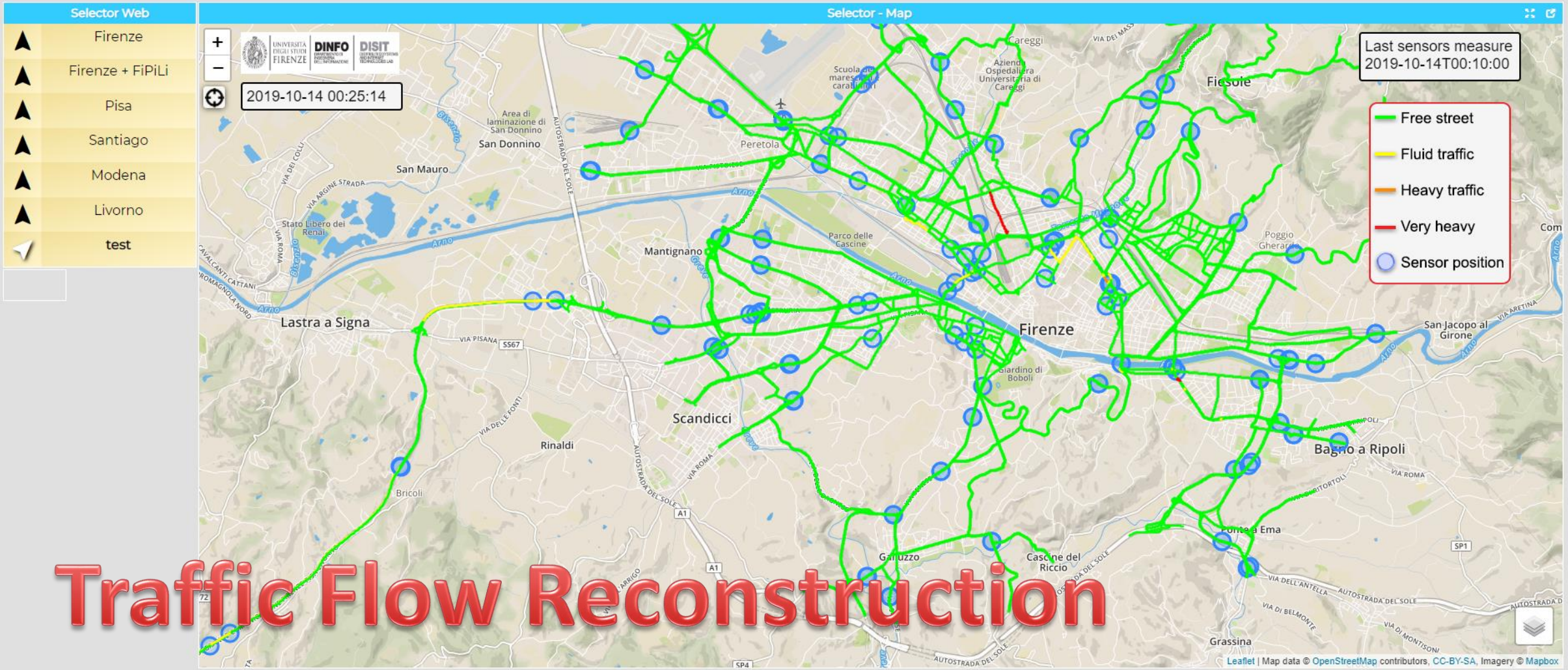
Firenze Oggi

Air Temperat... 6m



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

Traffic Flow Reconstruction for the cities



Traffic Flow Reconstruction

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==

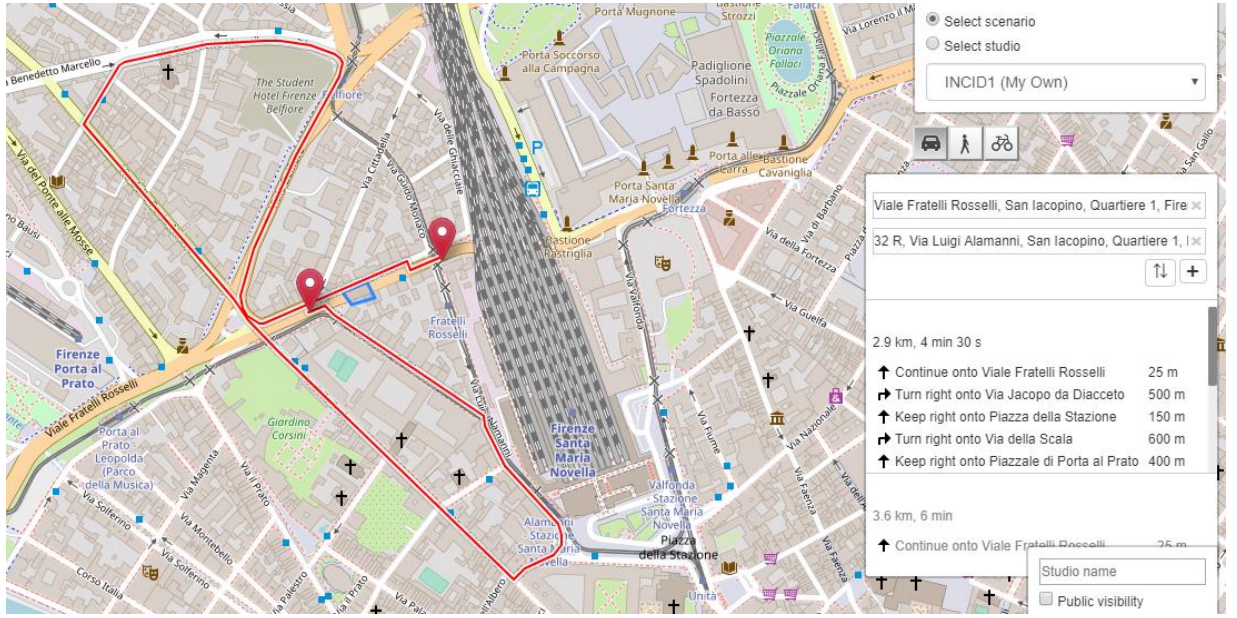
What-If Analysis

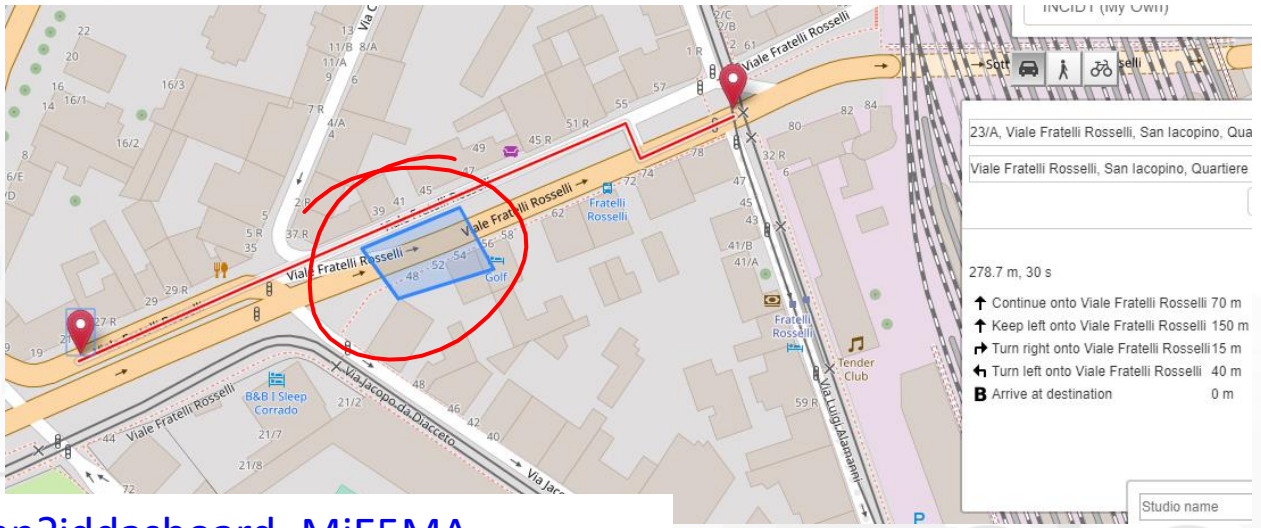
Accidents and elements blocking Points and Shapes taken into account for:

- Routing
- Traffic Flow reconstruction
- Evacuation paths
- Rescue team paths

Assessment on the basis of changes:

- Mobility demand assessment
- Mobility Offer assessment

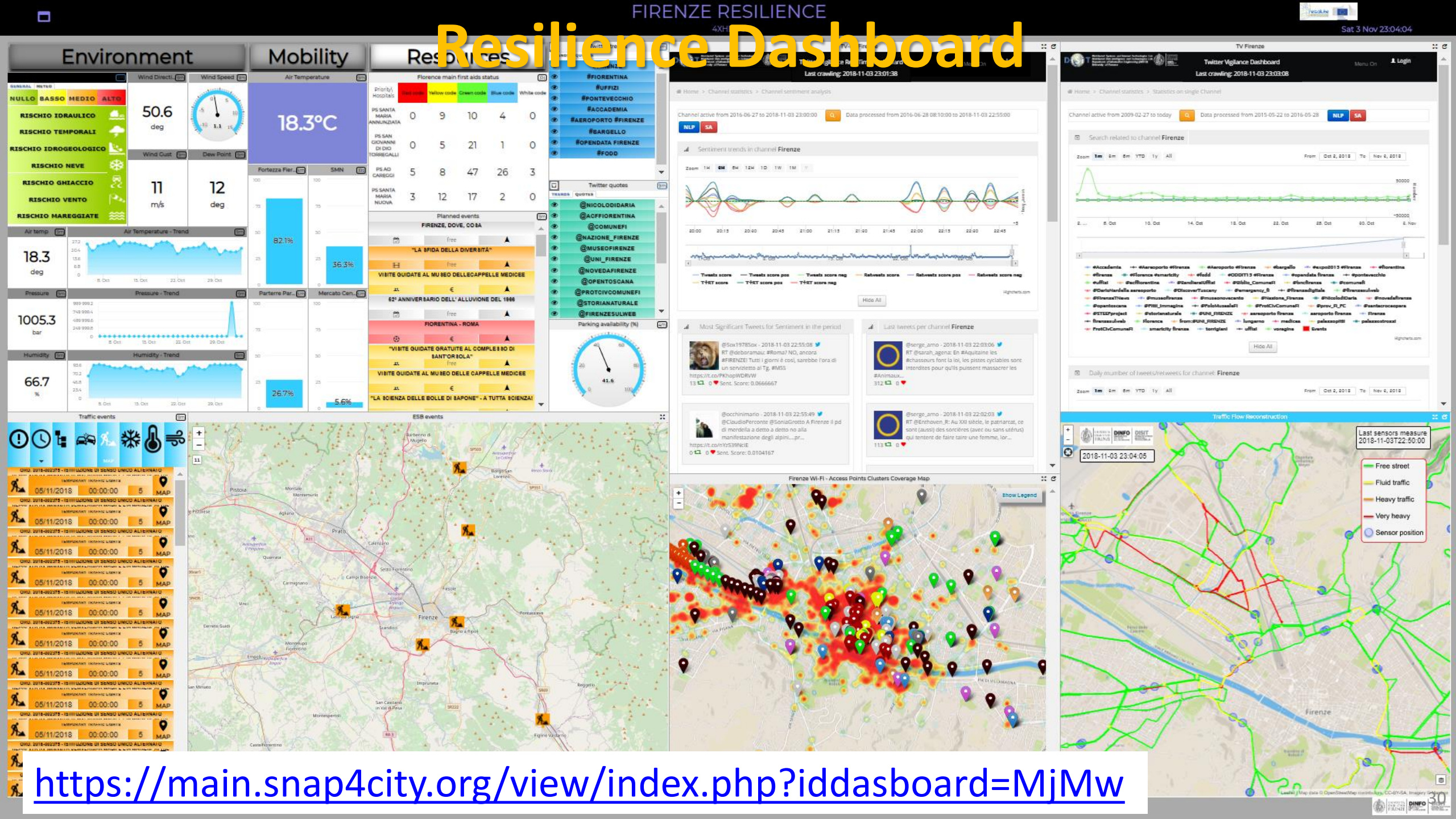




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

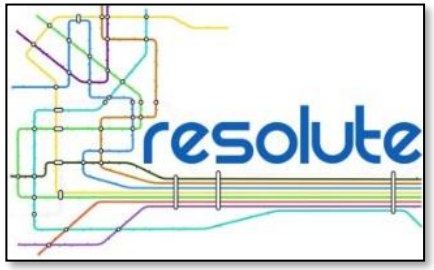

SIGNORVINO

Resilience Dashboard



https://main.snap4city.org/view/index.php?iddasboard=MjMw

ERMG: European Resilience Management Guide



Assessment and Management Support System

MONITORING

- Big Data Platform
- IoT/IoE/Open Data
- Real Time Dashboard
- Resilience Control Room
- Data Analytics
- Early Warnings
- Urban Traffic Manager Data Exchenge

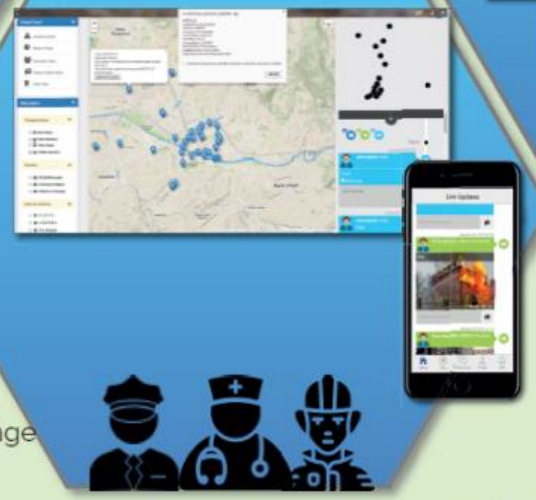
LEARNING

- Human Behavior Analysis
- Predictive Analytics
- Urban Transport System Dynamic Analysis
- Resilience Quantification
- Network Analysis

ANTICIPATING

- European Resilience Management Guidelines
- Game Based Training

RESPONDING



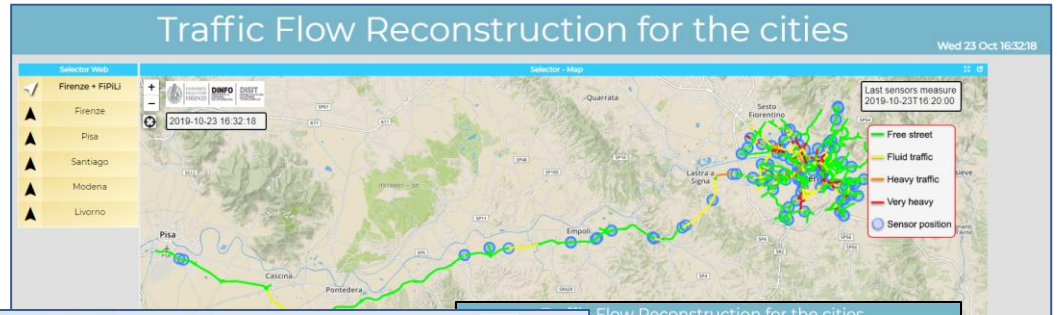
- Smart Decision Support Systems (DSS)
- Evacuation Decision Support
- Smart Intelligent Transport Systems
- Emergency Support Smart App
- Resilience DSS

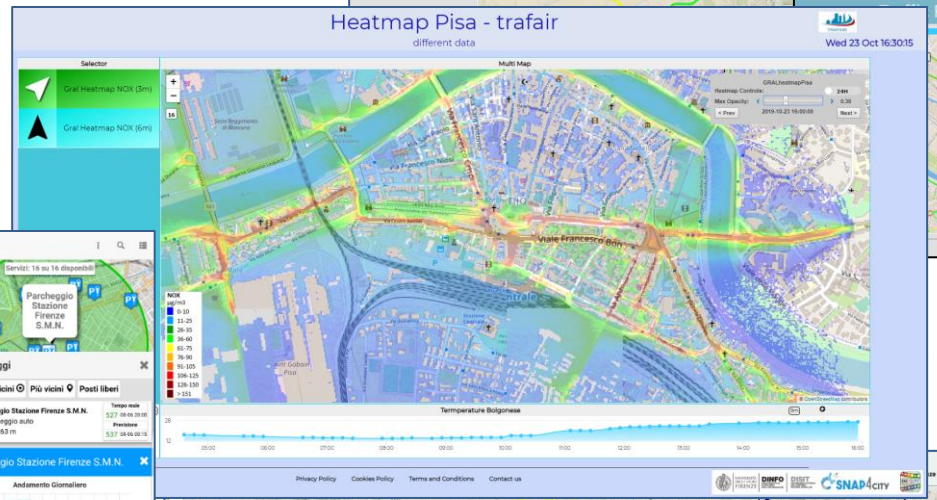
Tuscany Region

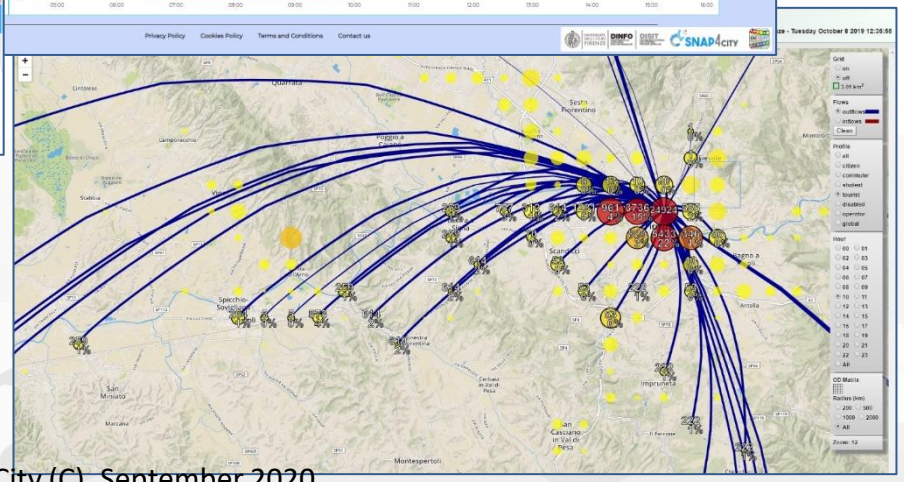
Firenze, Pisa, Livorno, Prato, etc.

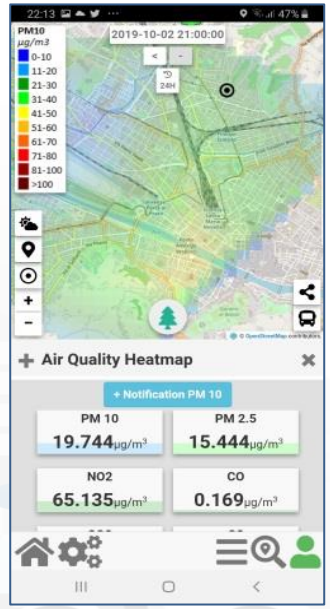
Tuscany Region

- **Dashboards & Services**:
  - **Mobility**: public transport operators schedule and paths, traffic Fi-Pi-Li main road, parking status and predictions, traffic sensors, Origin Destination matrix, routing, multimodal routing, etc.
  - **Social**: Hospitals and triage, etc.
  - **Environment**: sensors, heatmaps, alerting,
    - **Pollution** Forecast
    - **Weather** Forecast,
  - **Culture** and **Tourisms**
  - Etc.
- **Mobile App and MicroApplications:**
  - Tuscany in a Snap (all stores)
  - Tuscany where what… km4city (all stores)
- **Numbers**: 1.5 M complex events per day



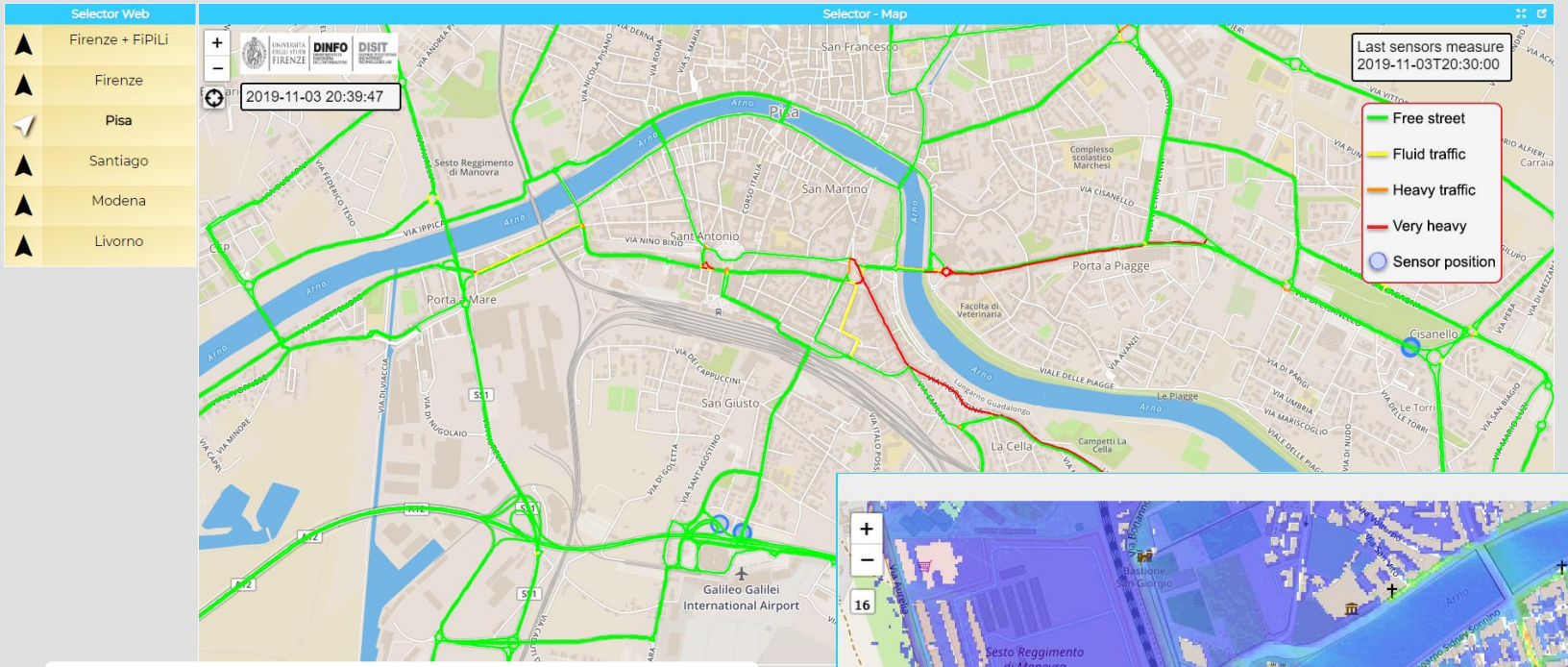


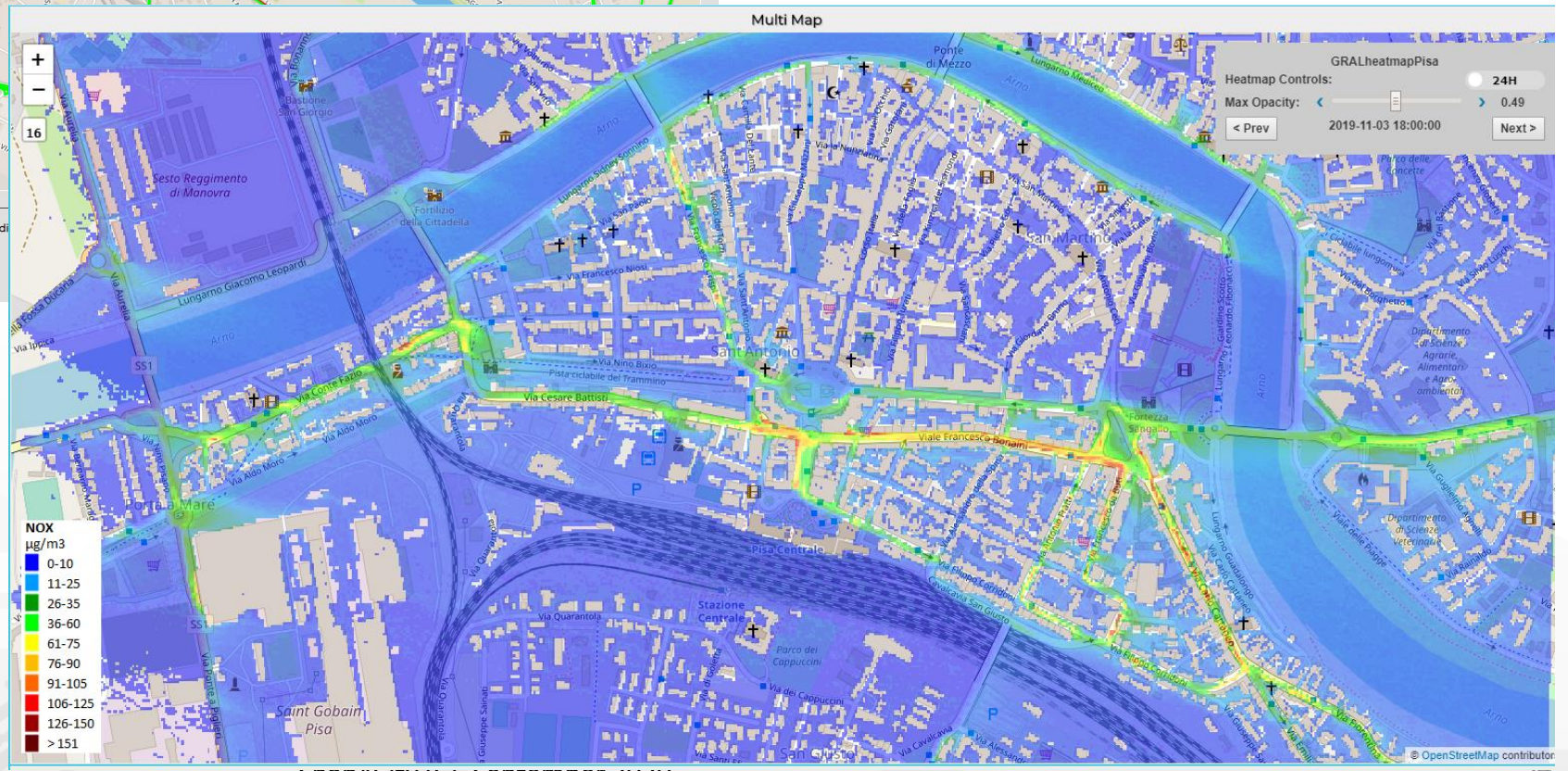




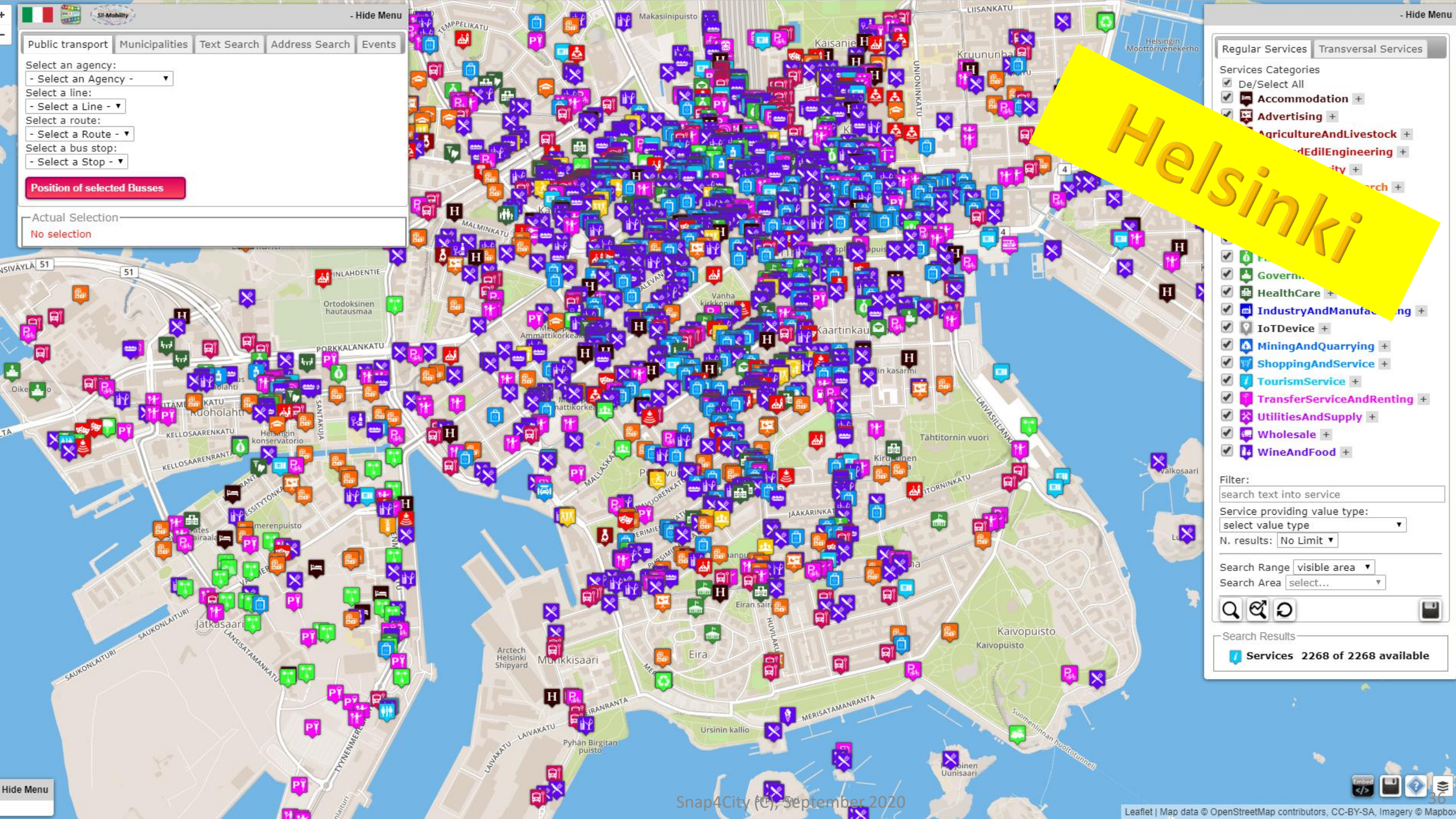
Traffic Flow Reconstruction for the cities

Sun 3 Nov 20:39:47





Helsinki


- Hide Menu
Public transport
Municipalities
Text Search
Address Search
Events
Select an agency:
- Select an Agency -
Select a line:
- Select a Line -
Select a route:
- Select a Route -
Select a bus stop:
- Select a Stop -
Position of selected Busses
Actual Selection
No selection
Hide Menu
- Hide Menu
Regular Services
Transversal Services
Services Categories
De/Select All
Accommodation
Advertising
HealthCare
IoTDevice
MiningAndQuarrying
ShoppingAndService
TourismService
TransferServiceAndRenting
UtilitiesAndSupply
Wholesale
WineAndFood
Filter:
search text into service
Service providing value type:
select value type
N. results:
No Limit
Search Range
visible area
Search Area
select...
Search Results
Services 2268 of 2268 available
Helsinki
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

Helsinki Case

- **Dashboards & Services**:
  - **Environment** & **Weather**, PM10, PM2.5,NO, SO2, CO, noise, etc.
    - Sensors values, Heatmap & **Alerts** on critical
    - FMI Enfuser prediction: PM10, PM2.5, ..
    - GRAL predictions PM10, validations
    - Private sensors in Jätkäsaari area (personal dashboards)
  - **Mobility**: Traffic Sensors, Operators, routing, multimodal routing, whatif
  - **Social**: Twitter Vigilance, early warning
  - **Life in Helsinki**: OD matrix people flow, Twitter Vigilance SA, hot places, etc.
  - **Tourism and Culture**
- **Mobile App and MicroApplications:**
  - Helsinki in a Snap (all stores)

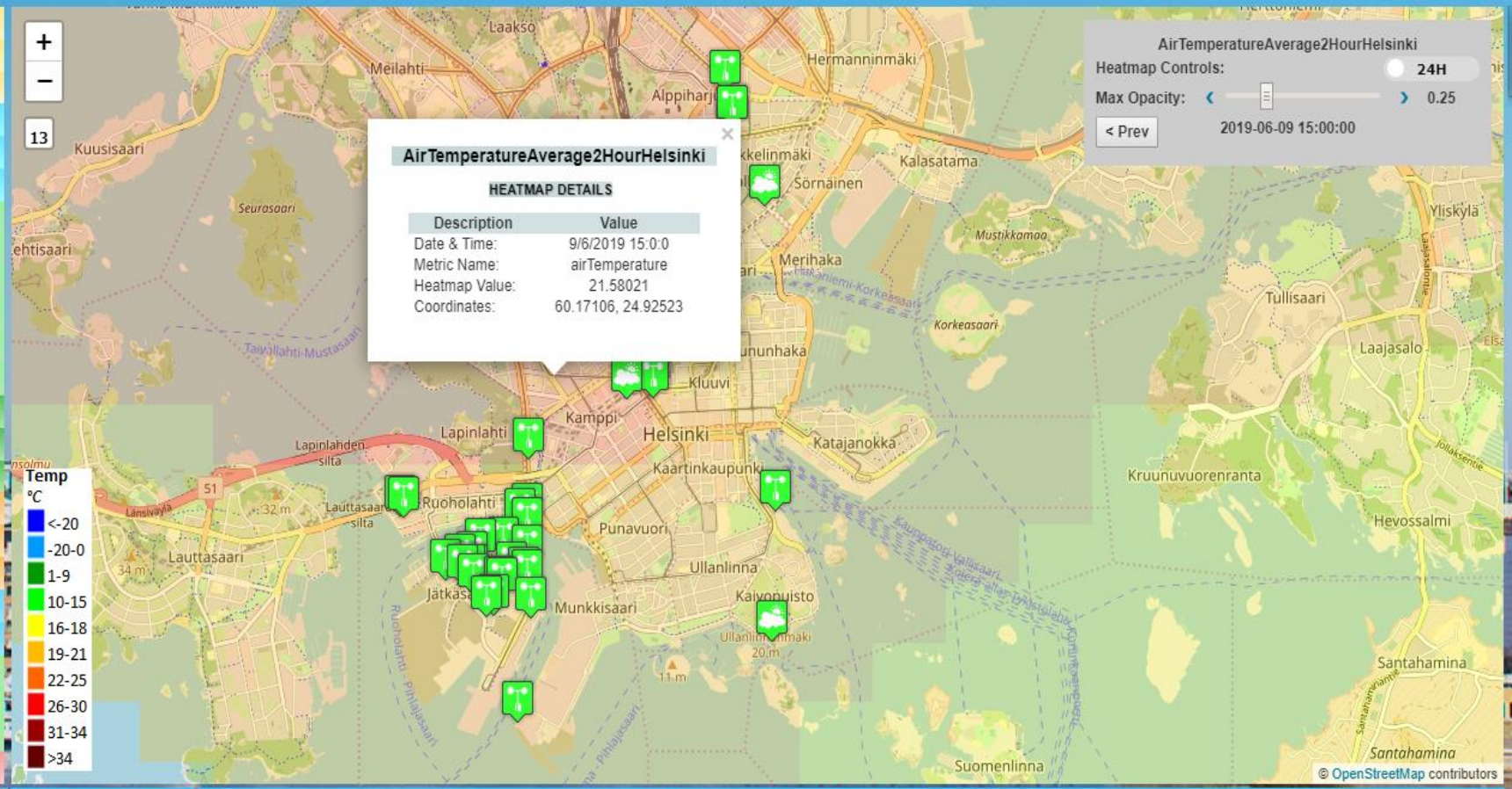
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==

Helsinki City Overview (H5a)

Please note that the data results are not always based on real data.

Sun 9 Jun 17:07:25

- BusStop
- Ticket sale
- Traffic Sensor
- Weather sensor
- Air Temp heatmap
- Humidity Heatmap
- Air Quality Sensors
- Noise sensors
- Noise Heatmap
- PM10 heatmap
- PM2.5 Heatmap
- NO2 heatmap
- Air Quality Index heatmap
- EAQI
- CAQI
- Enfuser pred. AQI
- Enfuser pred. PM10
- Enfuser pred. PM2.5
- Gral pred. PM10
- Gral pred. PM10 (6m)
- PM10 Jatkasaari
- PM2.5 Jatkasaari
- EAQI Jatkasaari
- Appreciated POIs



Weather sen... 9m

20.5

Weather sensor Helsinki Kaisaniemi - airTemperature 9m

The Life of Helsinki

Documentation

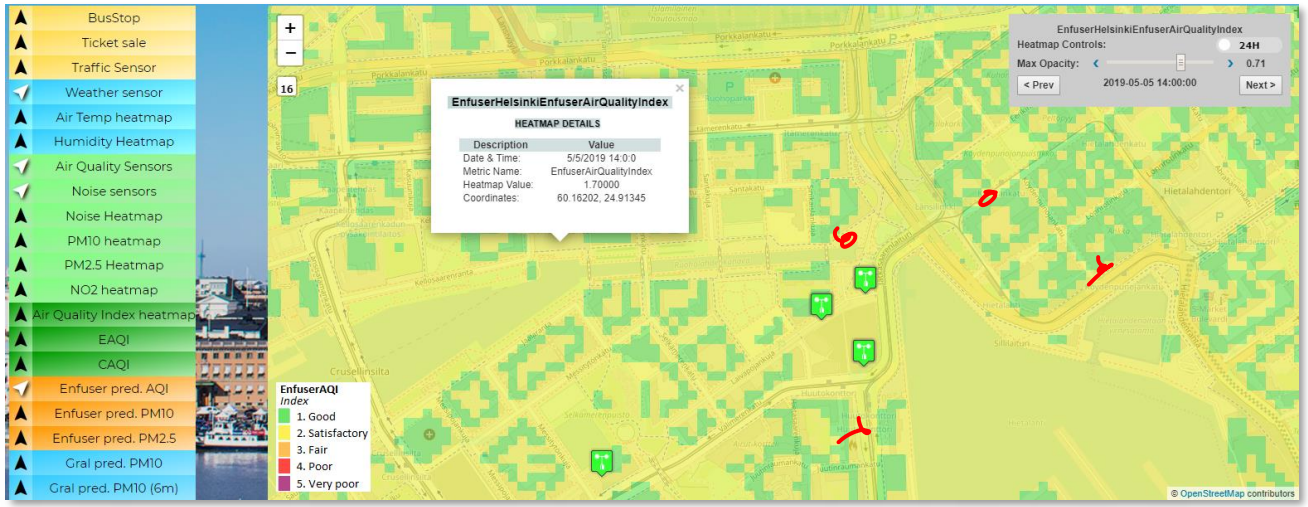
Forum Discussion

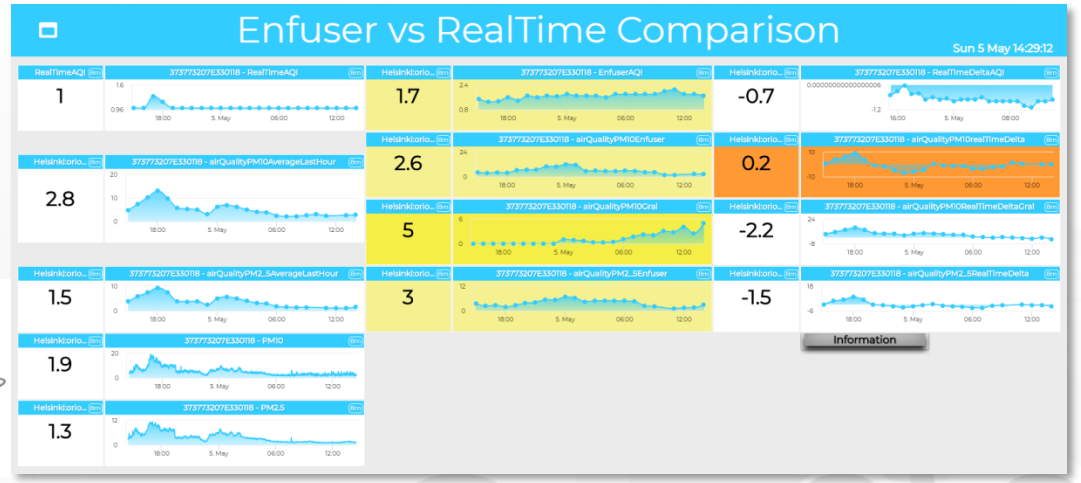
Survey

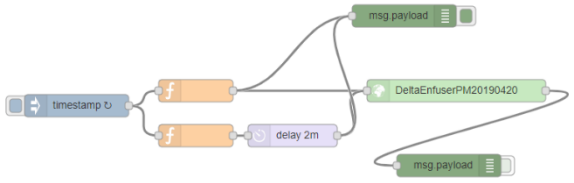
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==

Data Analytics: Enfuser predictions

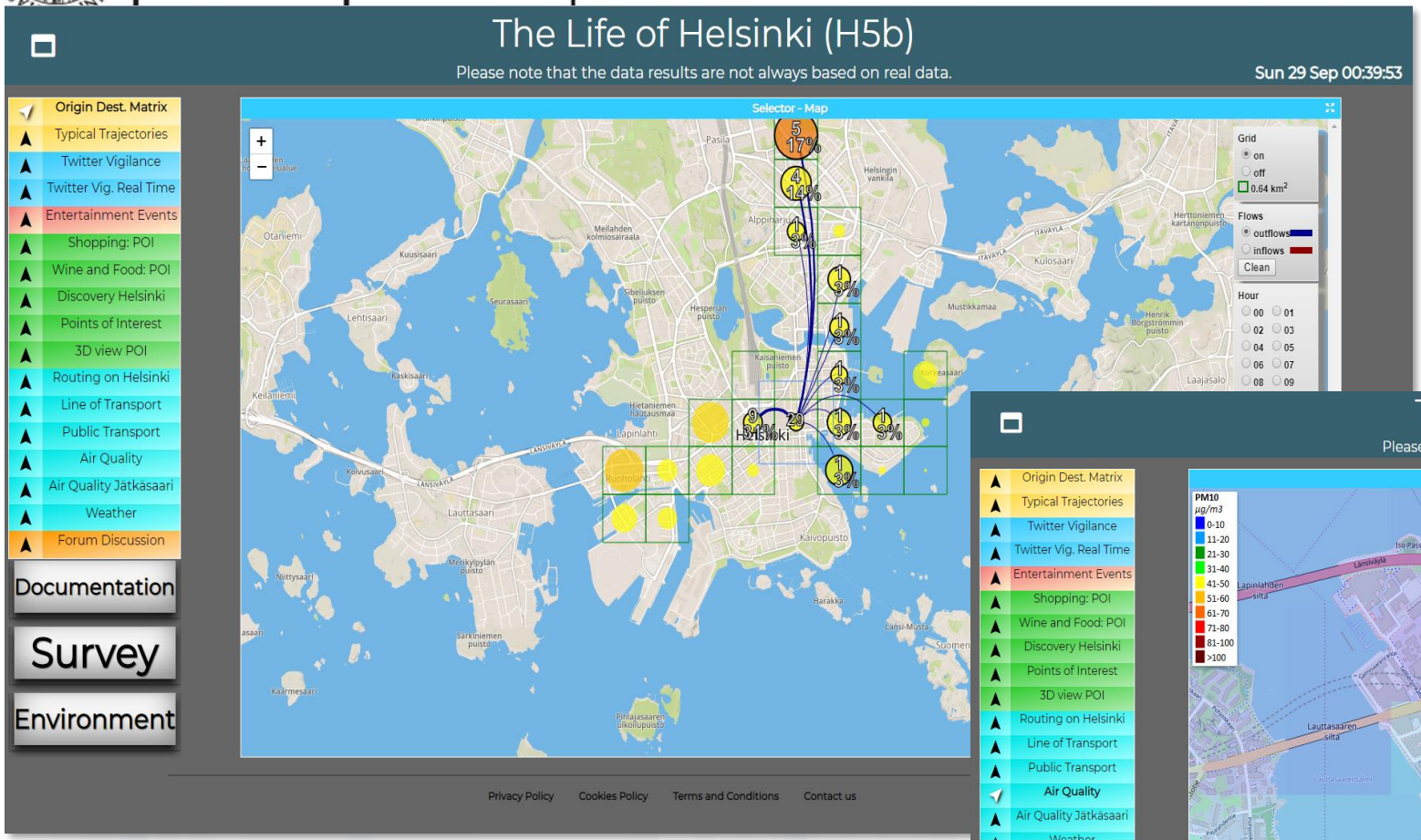
- **Enfuser predictions: AQI, PM10, PM2.5**
  - Data gathering, data processing for Piking
  - Delta Estimation Predictions vs Actual: on 12 points/sensors via R-Studio and IOT App
  - API for accessing data of Heatmaps in real time

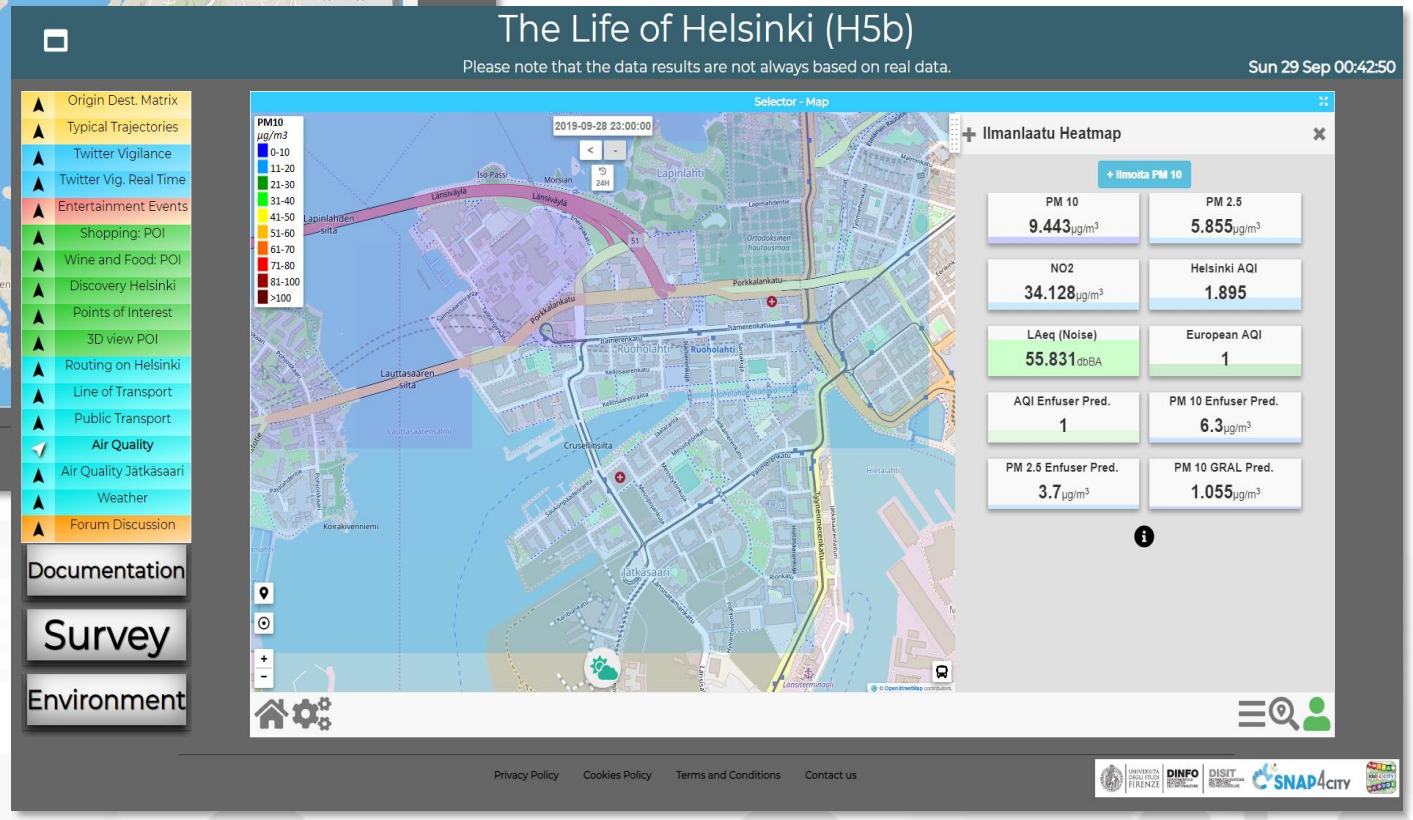






Helsinki





https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc1Mg==

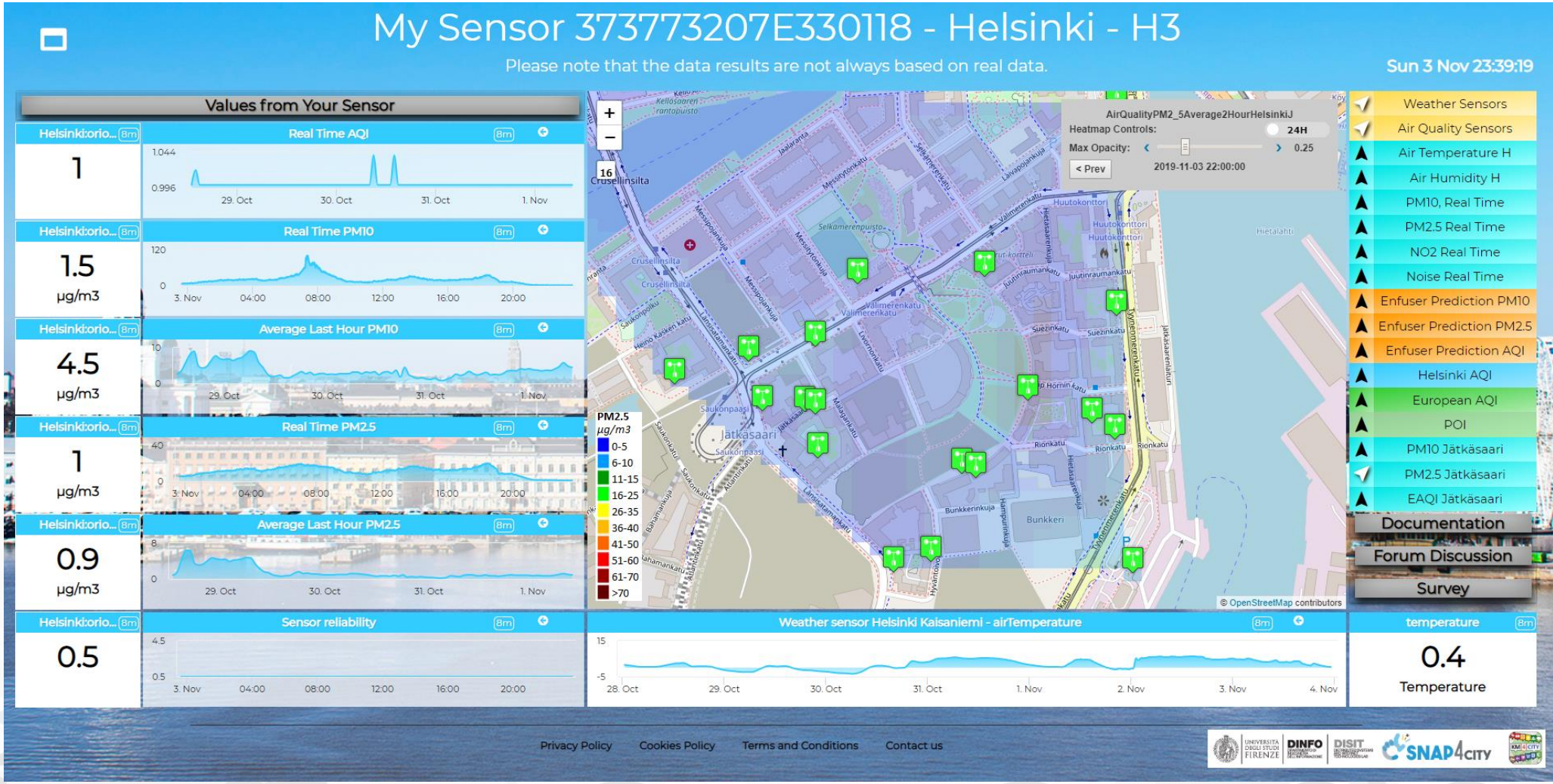
Helsinki

Environmental Data Predictions: GRAL

- **GRAL predictions: PM10, NOX, ….**
  - **Comparison wrt real time values in actual value of Sensors**
  - Graz Lagrangian Model.
- GRAL model takes into account:
  - pollution sources (for example the vehicles, their distribution on the streets, the about of pollution they produce according to their distribution over time and space, etc.),
  - structure of the city (streets and shape 3D of the buildings),
  - weather forecast (wind intensity and direction), etc.
- GRAL can be applied on NOX, PM10, PM2.5, … or any other particles

TRAFAIR

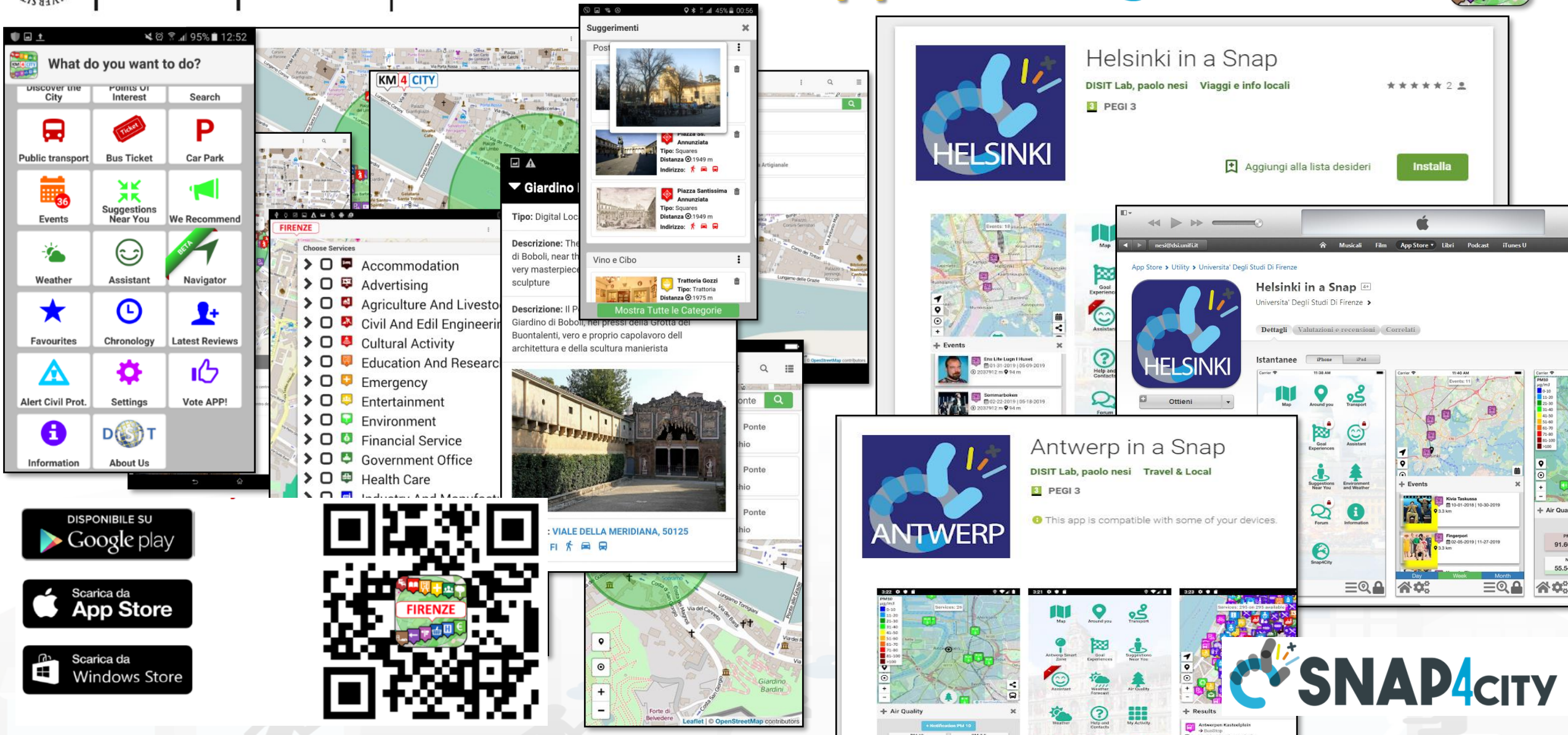
Environmental Devices hosted by Citizens



UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

Mobile Apps

SNAP4CITY KM 4 CITY



DISPONIBILE SU Google play

Scarica da App Store

Scarica da Windows Store

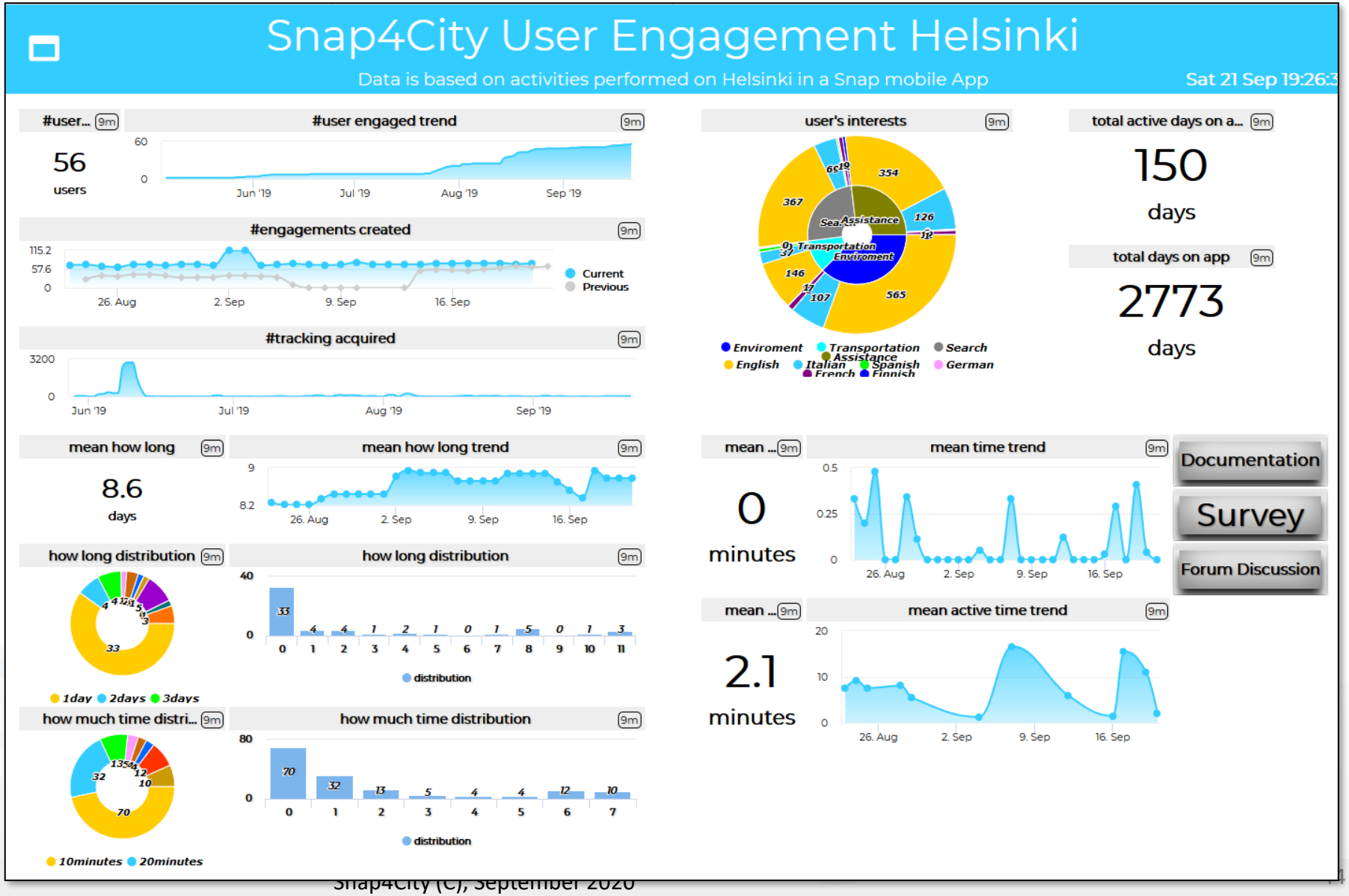
SNAP4CITY

Helsinki

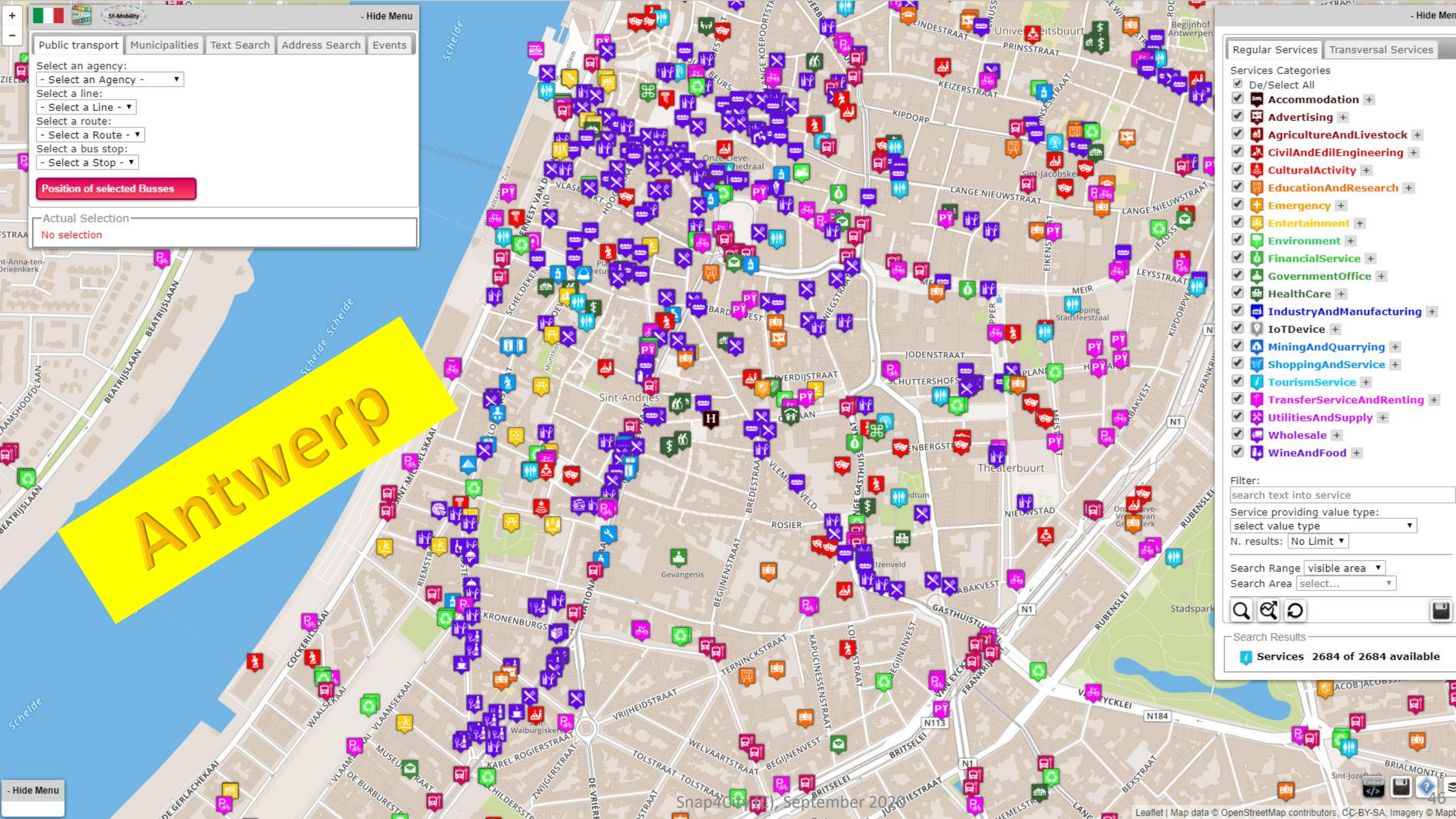
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc1OA==

Dashboard monitoring the Mobile App:

- Collecting the clicks
- Describing the community of users in terms of the profile aspects
- Measuring the time spend, and topics of interest of the users, etc.



Antwerp


- Hide Menu
Public transport
Municipalities
Text Search
Address Search
Events
Select an agency:
- Select an Agency -
Select a line:
- Select a Line -
Select a route:
- Select a Route -
Select a bus stop:
- Select a Stop -
Position of selected Busses
Actual Selection
No selection
Antwerp
- Hide Menu
Regular Services
Transversal Services
Services Categories
De/Select All
Accommodation
Advertising
AgricultureAndLivestock
CivilAndEdilEngineering
CulturalActivity
EducationAndResearch
Emergency
Entertainment
Environment
FinancialService
GovernmentOffice
HealthCare
IndustryAndManufacturing
IoTDevice
MiningAndQuarrying
ShoppingAndService
TourismService
TransferServiceAndRenting
UtilitiesAndSupply
Wholesale
WineAndFood
Filter:
search text into service
Service providing value type:
select value type
N. results:
No Limit
Search Range
visible area
Search Area
select...
Search Results
Services 2684 of 2684 available
- Hide Menu
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapb

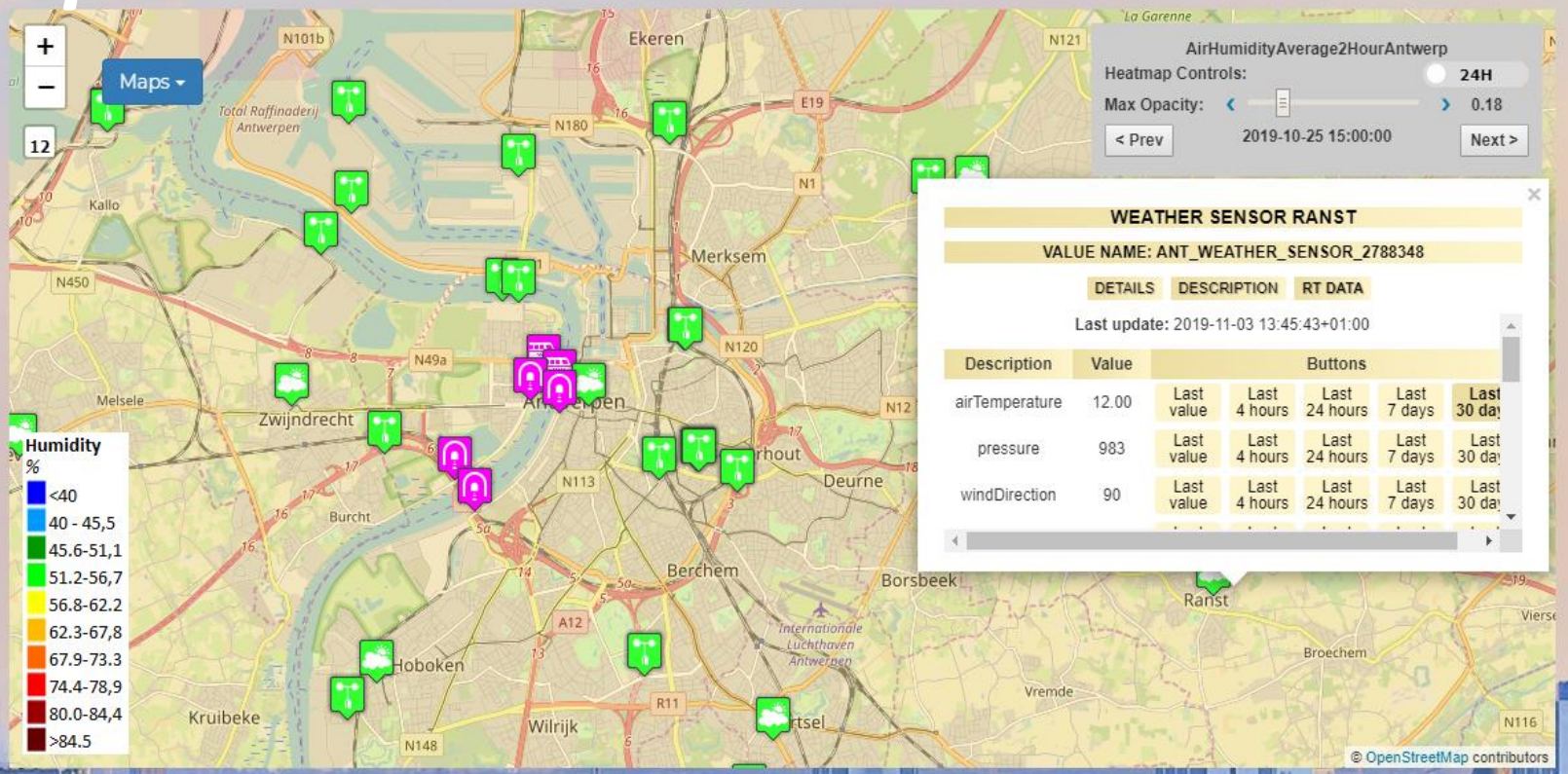
Antwerp

Antwerp City Overview - A5

Please note that the data results are not always based on real data.

Sun 3 Nov 14:09:43

- Cultural Activity
- Entertainment
- Tourism Service
- Education & Research
- Government Office
- Accommodation
- Air Quality Sensor
- Weather sensor
- PM10 Heatmap
- PM2.5 Heatmap
- Air Temperature Heatmap
- Humidity Heatmap
- NO Heatmap
- NO2 Heatmap
- SO2 Heatmap
- O3 Heatmap
- EAQI
- CAQI
- Biking Safe Heatmap
- Tunnels and Ferry
- Routing Scenario
- What-IF Routing



Weather sensor Zwijndr... 8m

11.9

Forum Discussion

Documentation

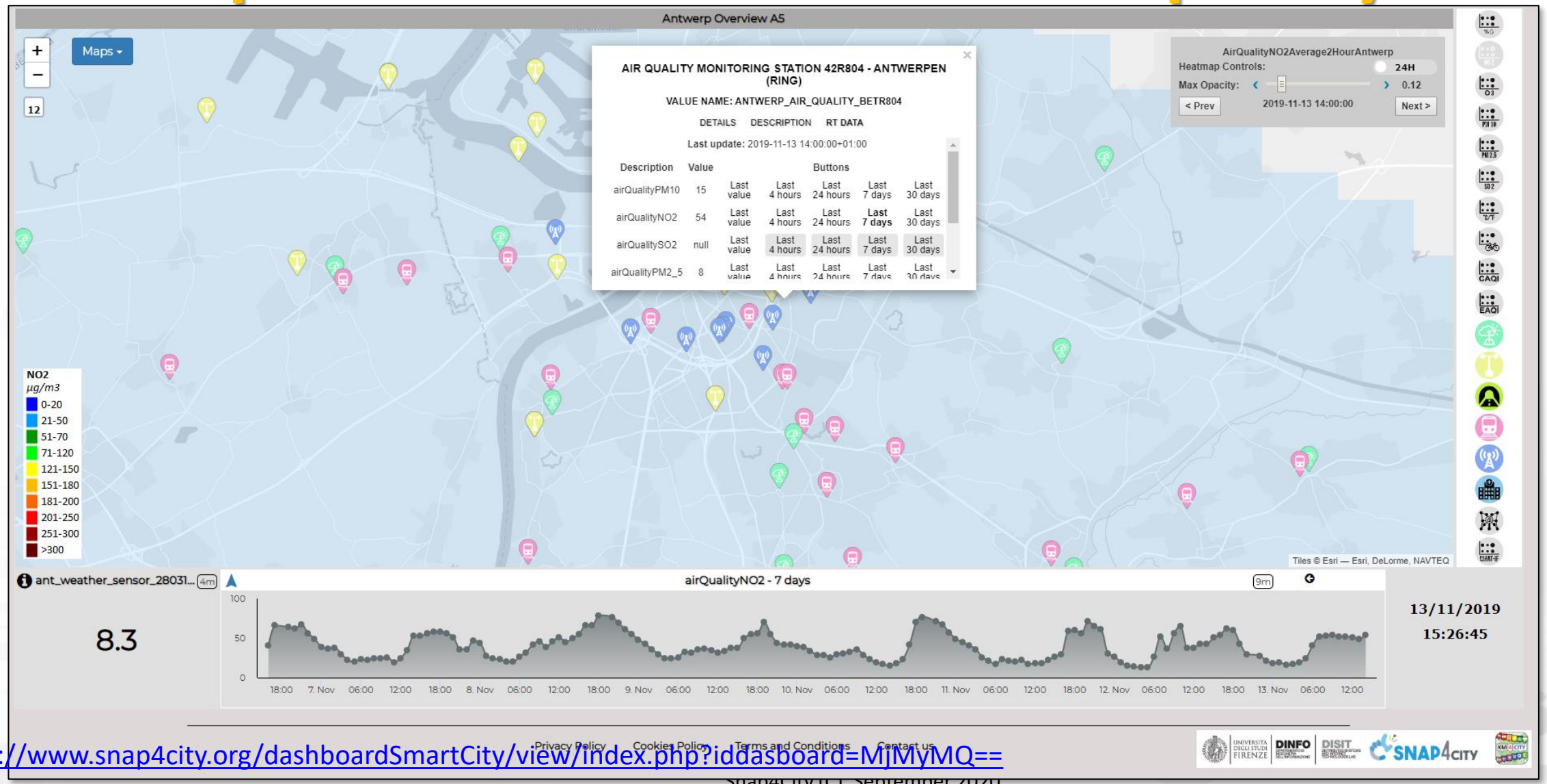
Survey

The Life of Antwerp

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNw==

Antwerp

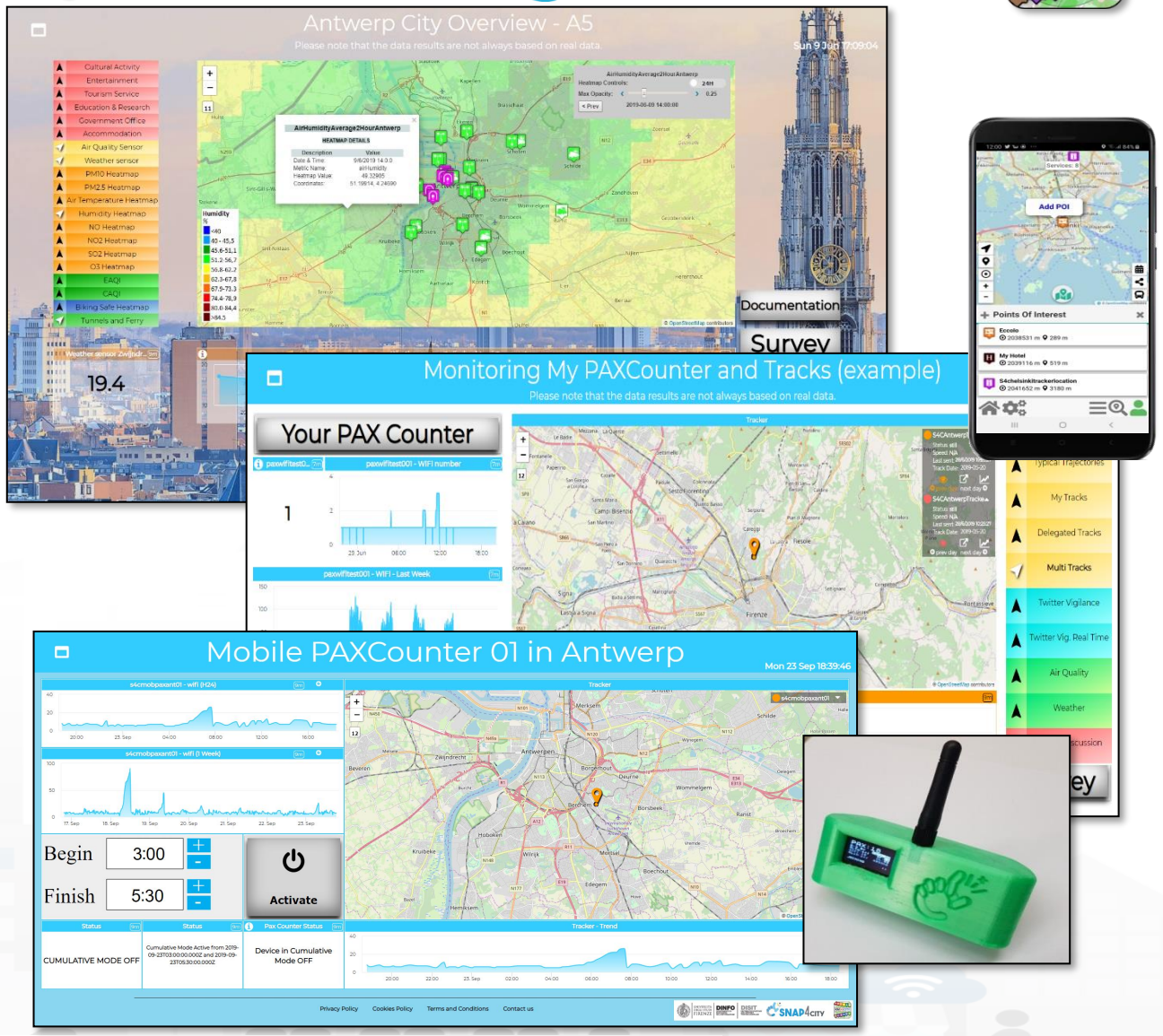
Unique Dashboard builder Multiple Styles



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjMyMQ==

Antwerp Case

- **Dashboards & Services**:
  - **Environment** & **Weather**: PM10, PM2.5,NO, SO2, CO, etc.
    - Heatmap & **Alerts** on critical
  - **Mobility**: public transport Operators schedule and path, monitoring of river crossing, routing, what-if
  - **PAX Counters:** museum and public services, mobile PAX Counter for events
  - **Social**: Twitter Vigilance, early warning
  - **Life in Antwerp**: OD matrix people flow, Twitter Vigilance SA, hot places, ...
  - **Tourism and Culture**
- **Mobile App and MicroApplications:**
  - Antwerp in a Snap (all stores)



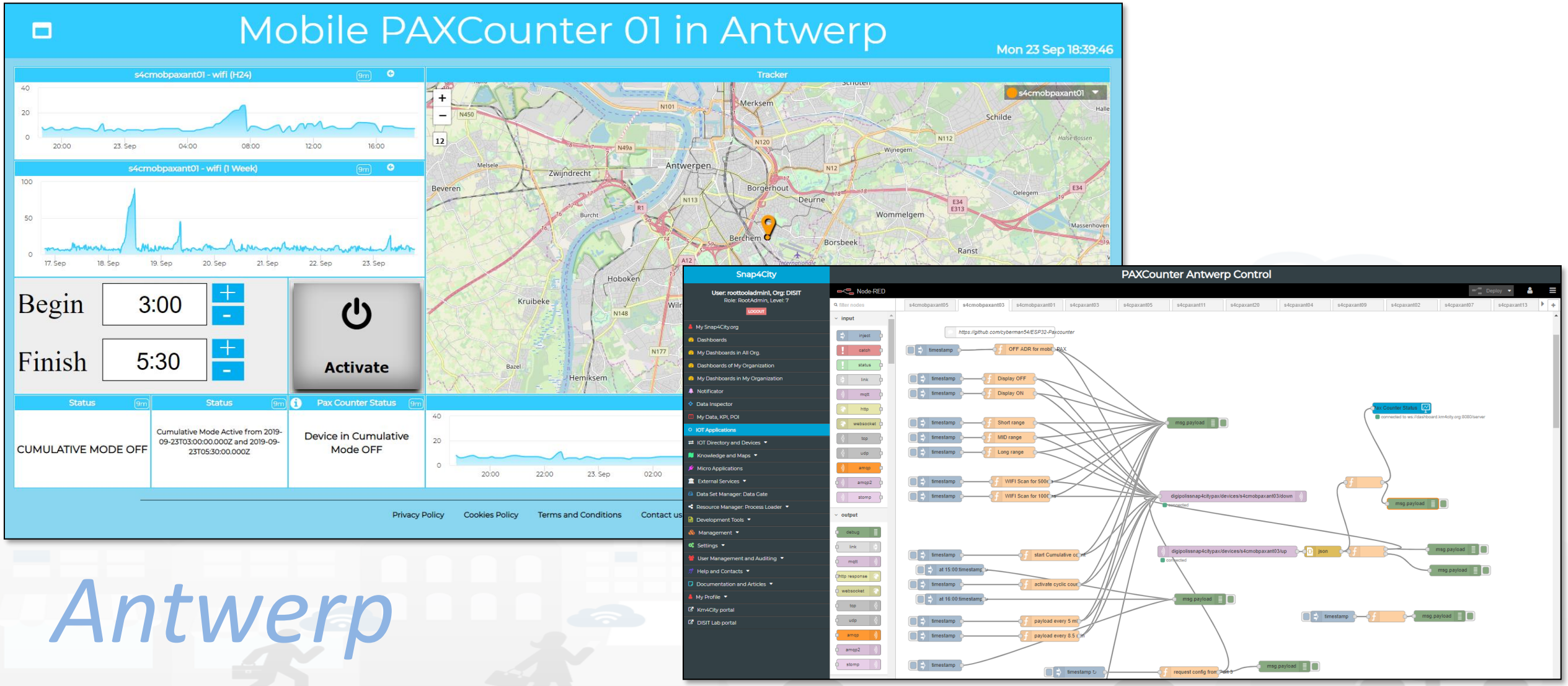
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNw==

PaxCounter devices

- Fixed PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Mobile PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Fixed PaxCounter(LoraWan+Wifi out)
  - Based on Wi-Fi- Bluetooth

https://www.snap4city.org/drupal/node/456

Programmable PAX counting



Antwerp

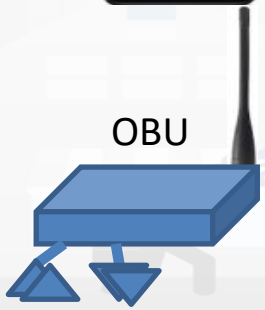
MyKPI: Tracking of Devices and Mobiles

- Real Time Trajectories for
  - Mobile Phone
  - Moving IOT Devices
  - OBU, Vehicular Kits
  - Multiple tracks
  - Day by day
- Micro Application

Mobile
PAX Counter

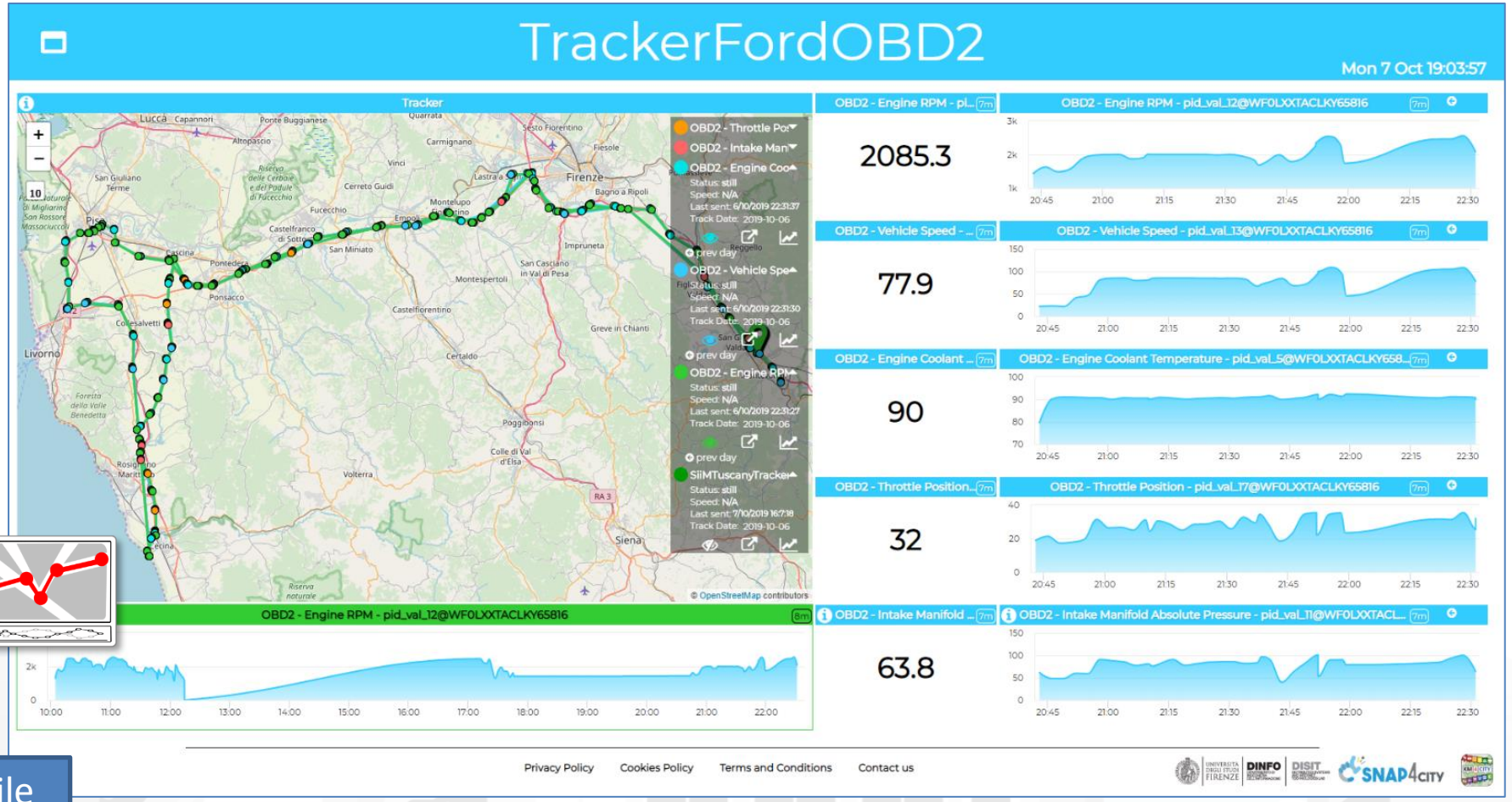
Apps

OBD2



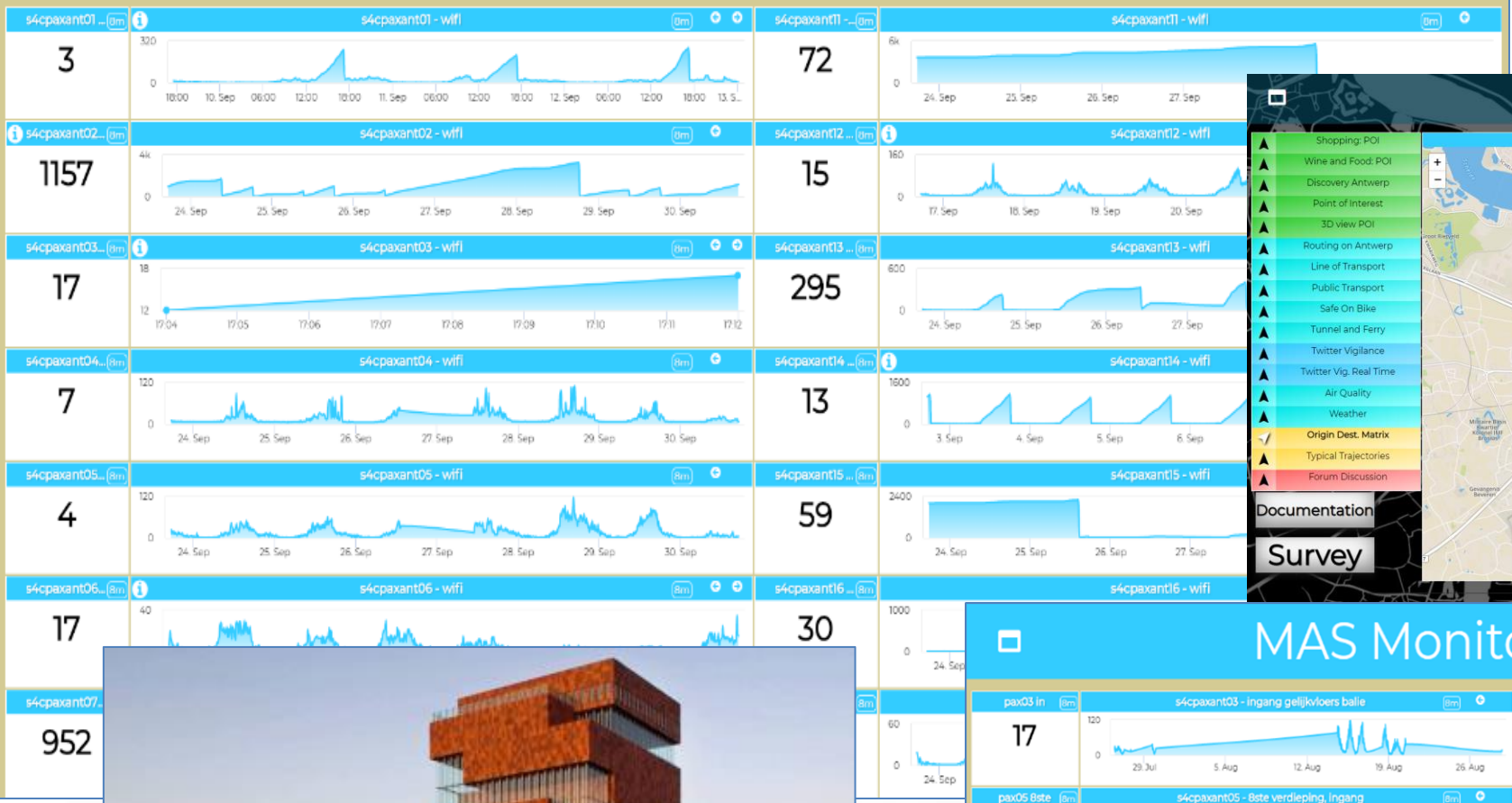
OBU

Mobile sensors



PAXCounter real time and trend

Mon 30 Sep 17:18:48



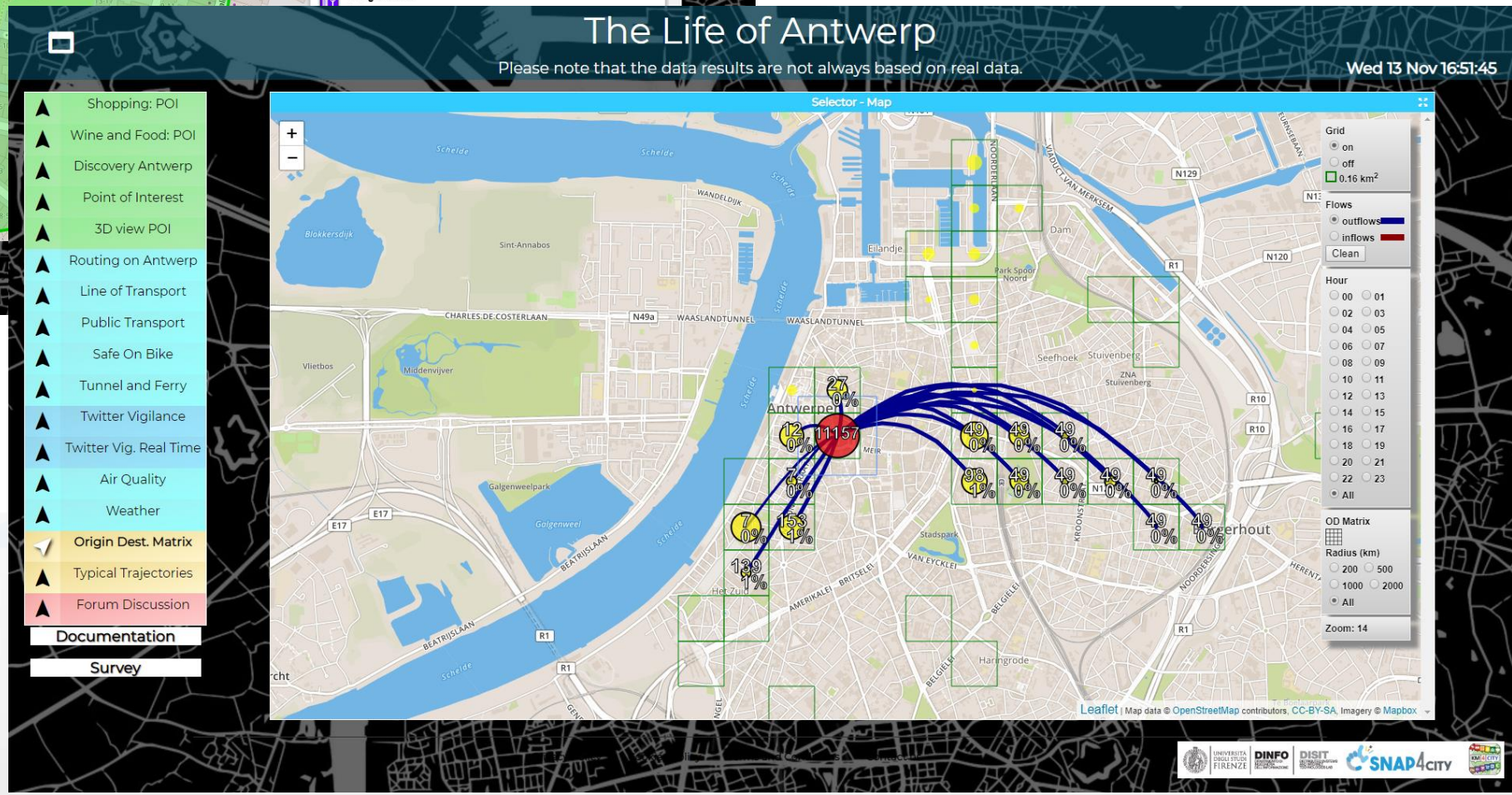
MAS Monitoring via PAXCounter

Mon 30 Sep 17:31:32

SNAP4CITY

KM4CITY

Antwerp



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTcwNg==

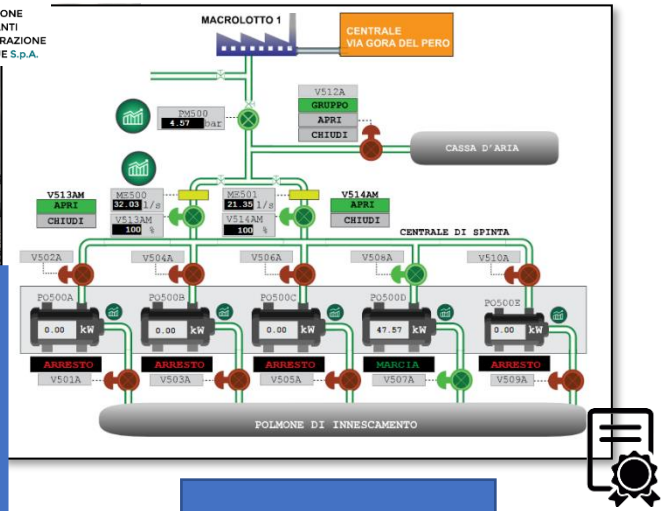
Prato
Smart City vs Industry 4.0

GIDA set up

Smart City data from many sources

IOT Applications

Dashboards and Apps



IOT Data Shadow Snap4City

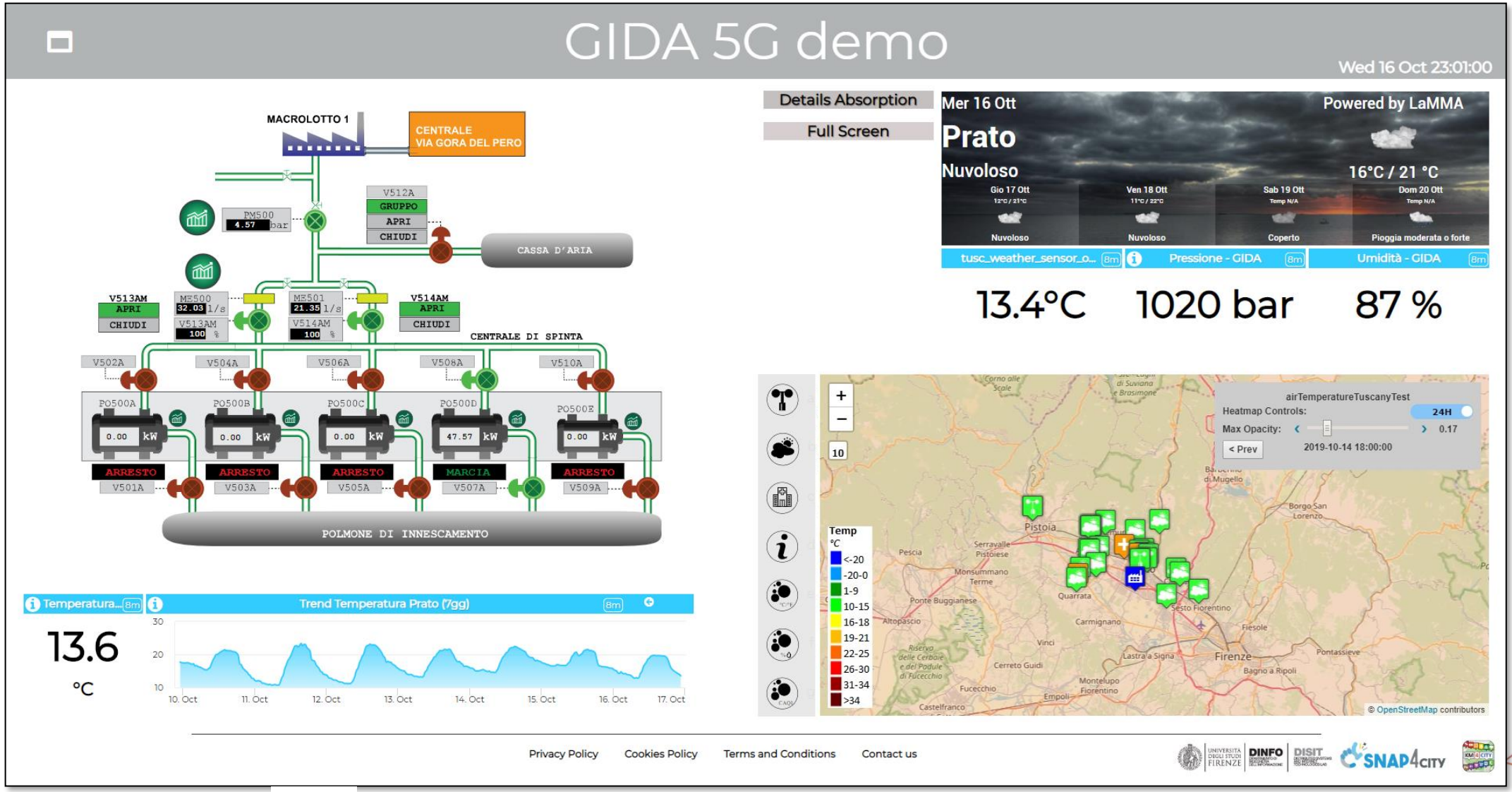
Big Data Analytics, Artificial Intelligence

ModBus to Snap4City Gateway Edge

5G network devices

Telemonitoring Telecontrol

Dashboards & Services:

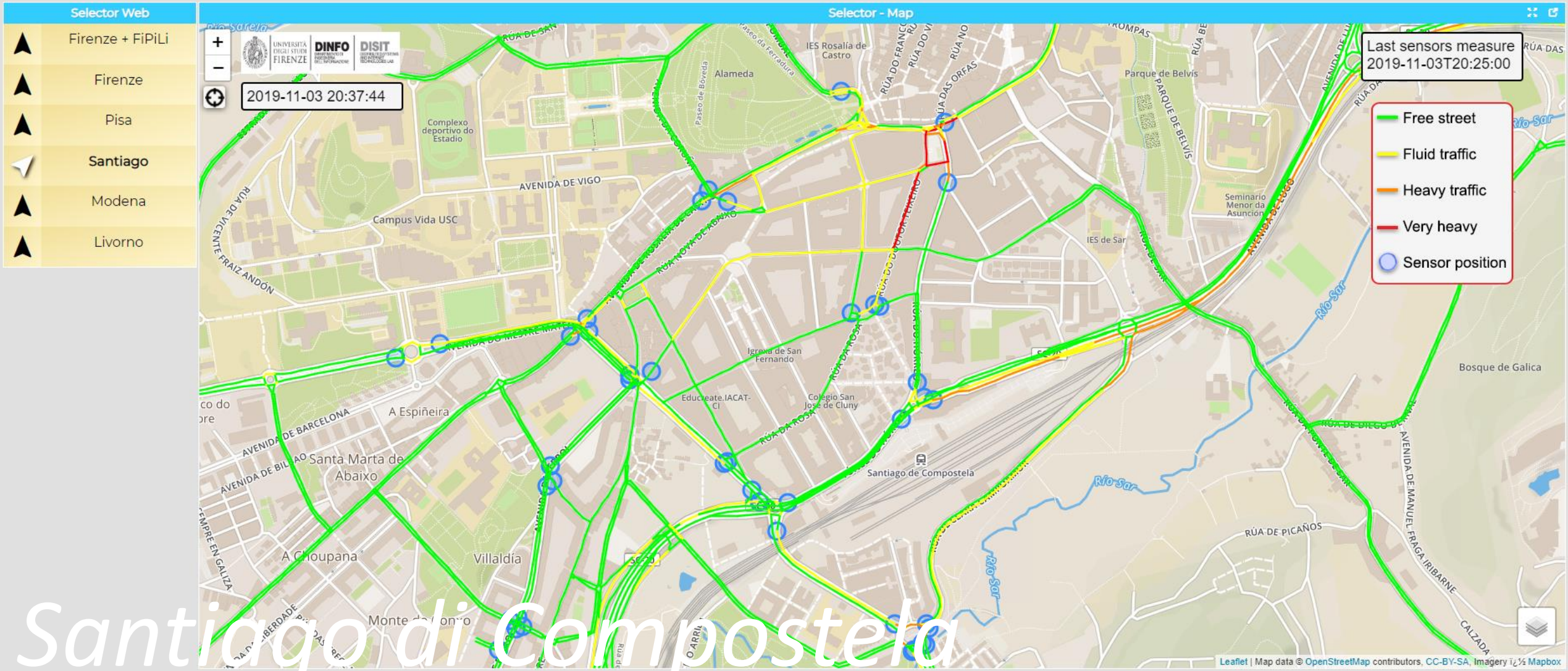


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIyNg==

Santiago di Compostela

Traffic Flow Reconstruction for the cities

Sun 3 Nov 20:37:43



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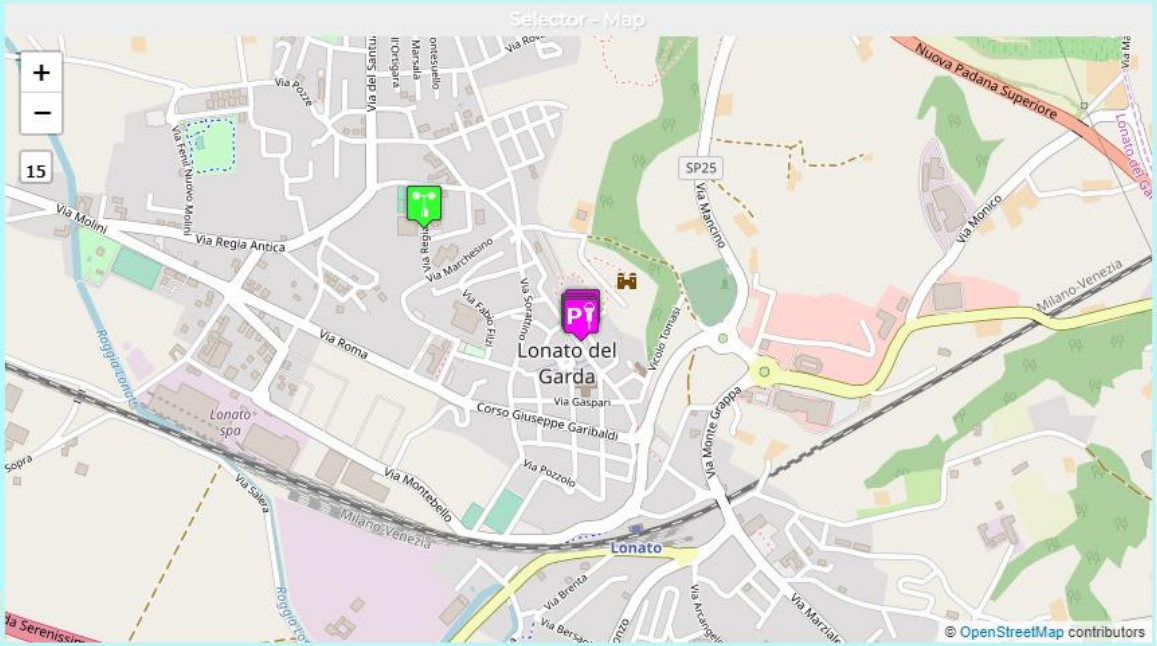
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==

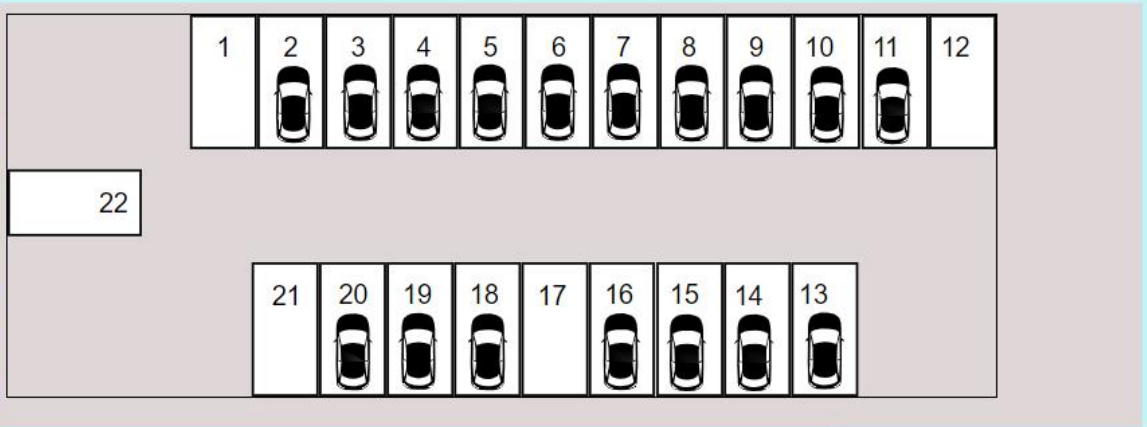
Lonato del Garda

Smart Lonato del Garda - cam

Tue 12 Nov 19:31:54

- Slot 1
- Slot 2
- Slot 3
- Slot 4
- Slot 5
- Slot 6
- Slot 7
- Slot 8
- Slot 9
- Slot 10
- Slot 11
- Slot 12
- Slot 13
- Slot 14
- Slot 15
- Slot 16
- Slot 17
- Slot 18
- Slot 19
- Slot 20
- Slot 21
- Slot 22
- Environment
- other





view cam

Slot 1 - Status 9m

0

status

Slot 15 - Seconds of Occupancy 9m

pressure 9m

976.2

mbar

humidity % 9m

82.7

%

temperature 9m

10.7

°C

AirSensEUR_RVB01 - temperature (week) 9m

AVG time of free slot 9m

08 minuti

5

free slots

Median of Busy Slots 9m

1 ora e 23 minuti

Max Present Duration 9m

53 ore e 01 minuto

View main


Roma (I)

Roma Demo3 (Qualità dell'Aria)

Thu 17 Sep 16:13:28

IT2012A
IT2172A
IT0889A
IT0884A
IT1906A
IT1841A
IT0887A
IT0953A
IT0956A
IT0825A
IT1836A
IT0957A
IT0828A
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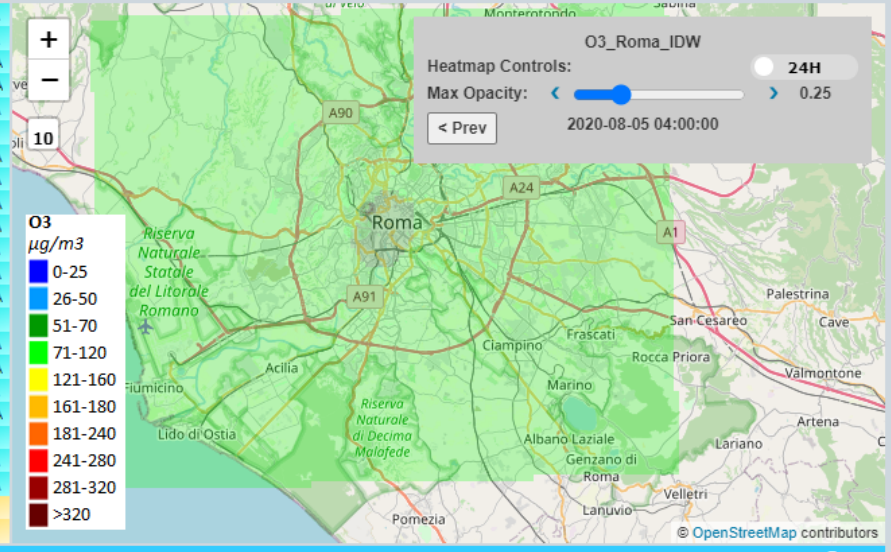
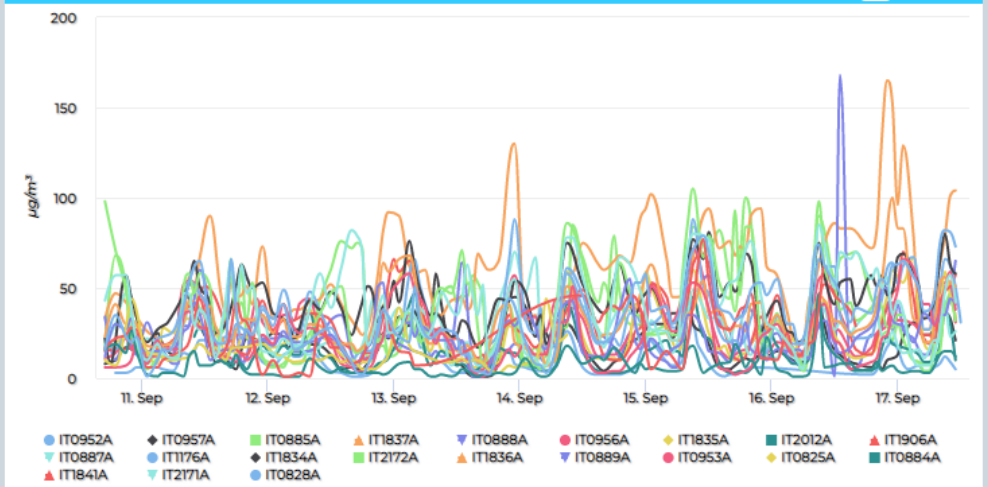
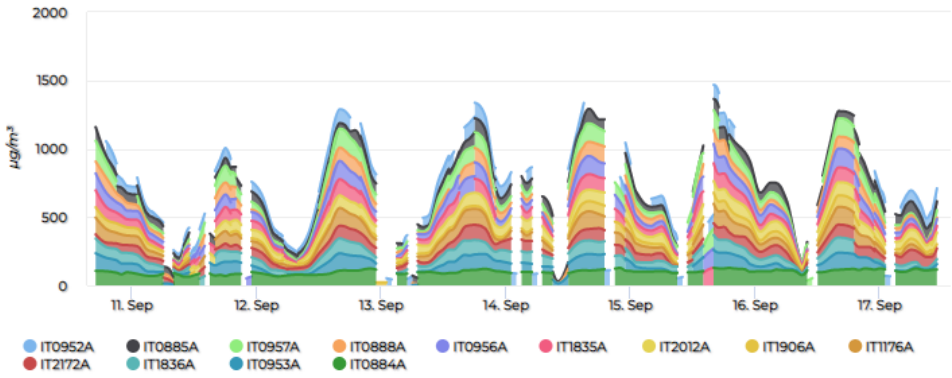
IT1834A
O3
NO2



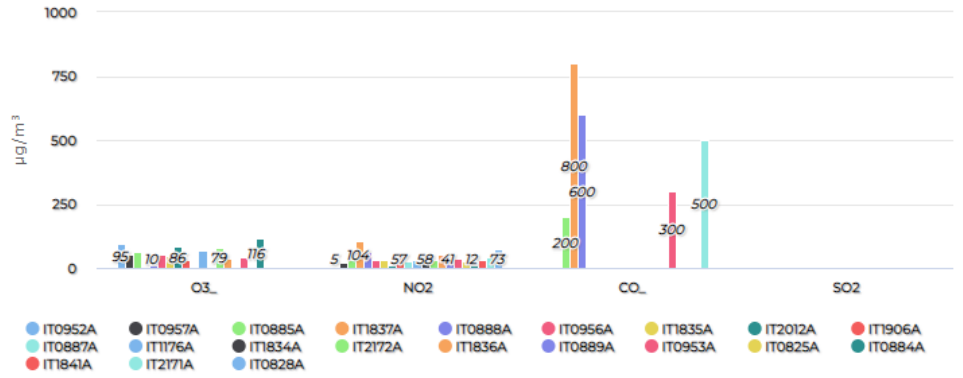
Andamento nel Tempo di NO2 rilevato nelle stazioni in Roma



Andamento nel Tempo di O3 rilevato nelle stazioni in Roma (stacked)



Dati in Tempo reale inquinanti in Roma e provincia



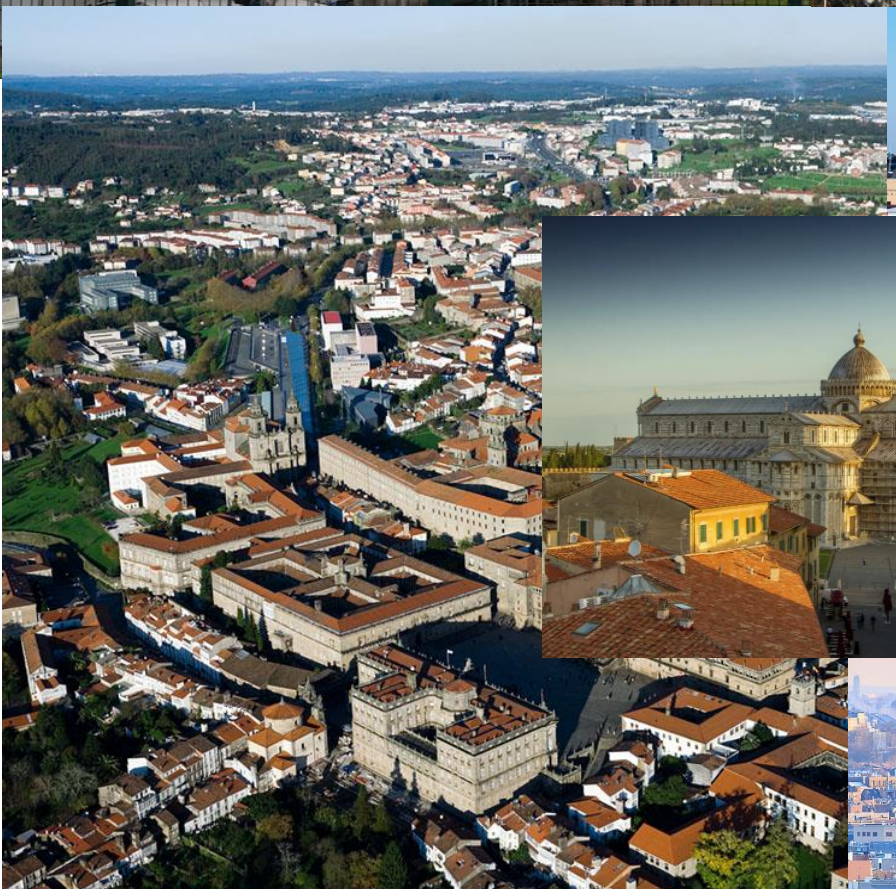
Valori Inquinanti in tempo reale, mappe

value type / value name	O3_	NO2	CO_	SO2
IT0952A	95	5		
IT0957A	54	21		
IT0885A	65	31	200	
IT1837A		104	800	
IT0888A	10	65	600	
IT0956A	51	31		
IT1835A	48	34		
IT2012A	86	10		
IT1906A	30	57		
IT0887A		26		
IT1176A	67	31		
IT1834A		58		
IT2172A	79	32		
IT1836A	36	51		
IT0953A	40	38	300	1.2
IT0889A		41		
IT0825A		24		
IT0884A	116	12		
IT1841A		29		
IT2171A		42	500	
IT0828A		73		

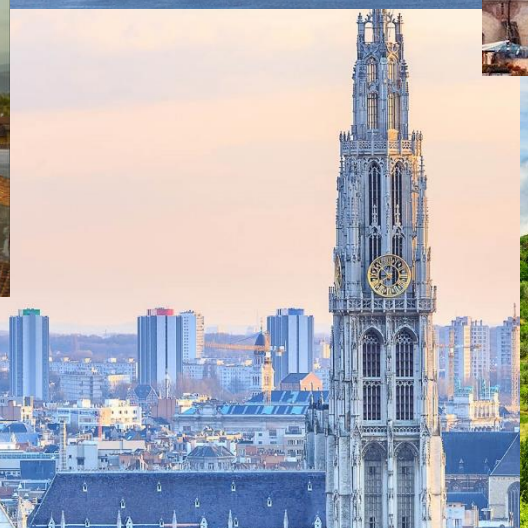
Home

Trasporti







https://www.snap4city.org/4

- Scenario: MOBIMART Interreg: MOBilità Intelligente MARe Terra
- Scenario: City of Roma case, mobility and environmental data
- Scenario: Herit-Data video and aims
- Scenario: Control Room vs Video Wall
- Scenario: Snap4Home the case of: Alexa, Philips, Sonoff, TP-link, etc. (Italiano)
- Scenario: how to manage maintenance and accidents workflows
- Scenario: Snap4Home, how to exploit Snap4City solution on home automation
- Scenario: Energy Monitoring
- Scenario: Multipurpose User Engagement Tools
- Scenario: 5G Enabled Water Cleaning Control (smart city, industry 4.0)
- Scenario: High Level Control of Industrial Plant (industry 4.0)
- Scenario: Vehicle Monitoring via OBD2
- Scenario: Events and Museums Monitoring in Antwerp
- Scenario: High Resolution Prediction of Environmental Data
- Scenario: Mobility and Transport Analyses in multiple cities
- Scenario: People Flow Analysis via Wi-Fi
- Scenario: Antwerp Pilot on Environmental Data
- Scenario: Helsinki Pilot on Environmental Data
- Scenario: Firenze Smart City Control Room
- Scenario: Mobile & Web App: Toscana Where What … Km4City, Toscana in a Snap
- Scenario: Helsinki Pilot on User Behaviour
- Scenario: Antwerp Pilot on User Behaviour

- Data Analytic: Origin Destination Matrices, Algorithms and tools
- Data Analytic: Traffic Flow Reconstruction
- Data Analytic: in general, and the cases of Antwerp and Helsinki
- Data Analytic: Predicting Air Quality
- Data Analytic: Analyzing Public Transportation Offer wrt Mobility Demand

TOP

DASHBOARDS: FROM CITY DASHBOARD TO APPLICATIONS


City Today
0 ACCIDENTS
KPI Dashboard


Snap4Ispra – KPI Dashboard
SVG Energy ISPRA HighLevel
City Today
ANALYSIS

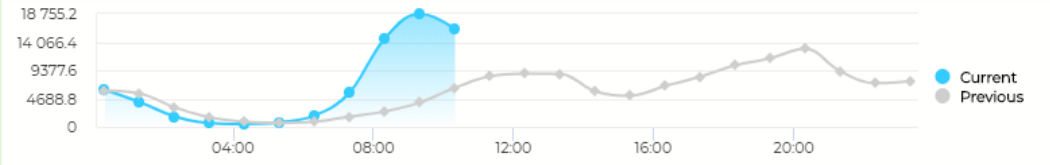
Traffic Flow Monitoring - Firenze - Cloned2

Mon 27 Jul 10:42:17

 # IN FLOW 9m

16219 #ofvehicles

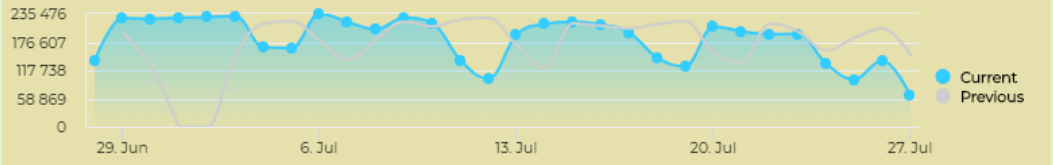
Firenze IN Traffic Flow (number of vehicles) 9m



Inc Daily Inp... 9m

65025 #ofvehicles

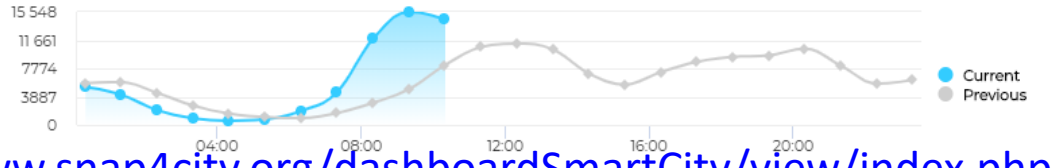
Daily Inputs (monthly) (last value is incremental, real time) 9m



 # OUT FLOW 9m

14510 #ofvehicles

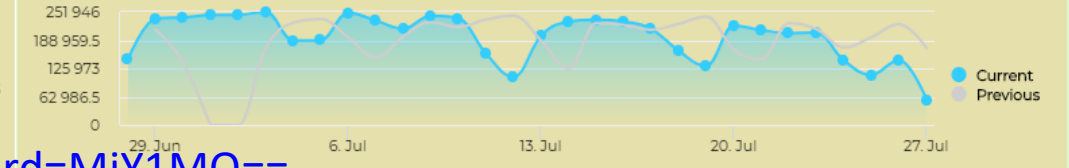
Firenze OUT Traffic Flow (number of vehicles) 9m



Inc Daily Out... 9m

56810 #ofvehicles

Daily Outputs (monthly) (last value is incremental real time) 9m

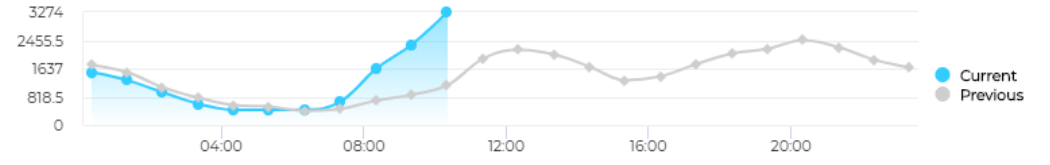


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjY1MQ==

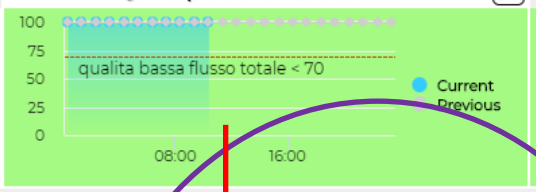
ZTL in 9m

3274 #ofvehicles

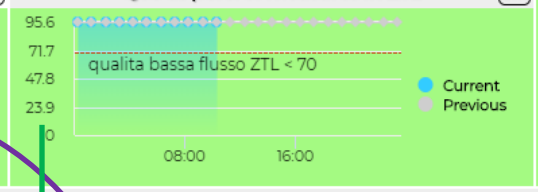
ZTL in Traffic Flow daily trend, entering in ZTL 9m



QoS as perc. of measures taken 9m



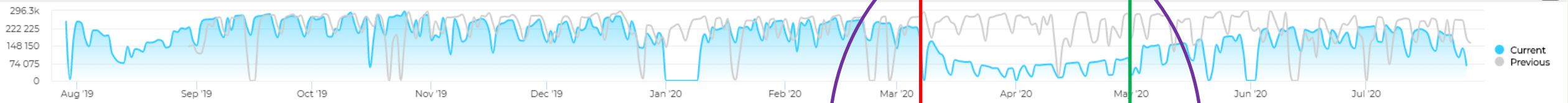
QoS as perc. of measures in ZTL 9m



27/07/2020

10:42:17

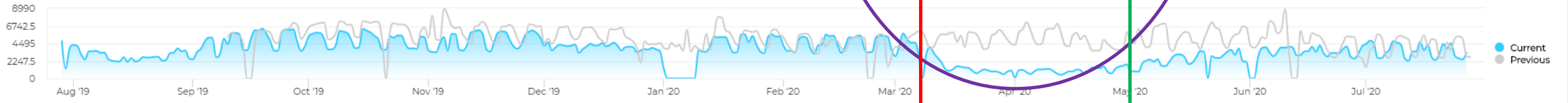
inflow total of the day, yearly 9m



outflow total over the day Yearly 9m

COVID-19 time

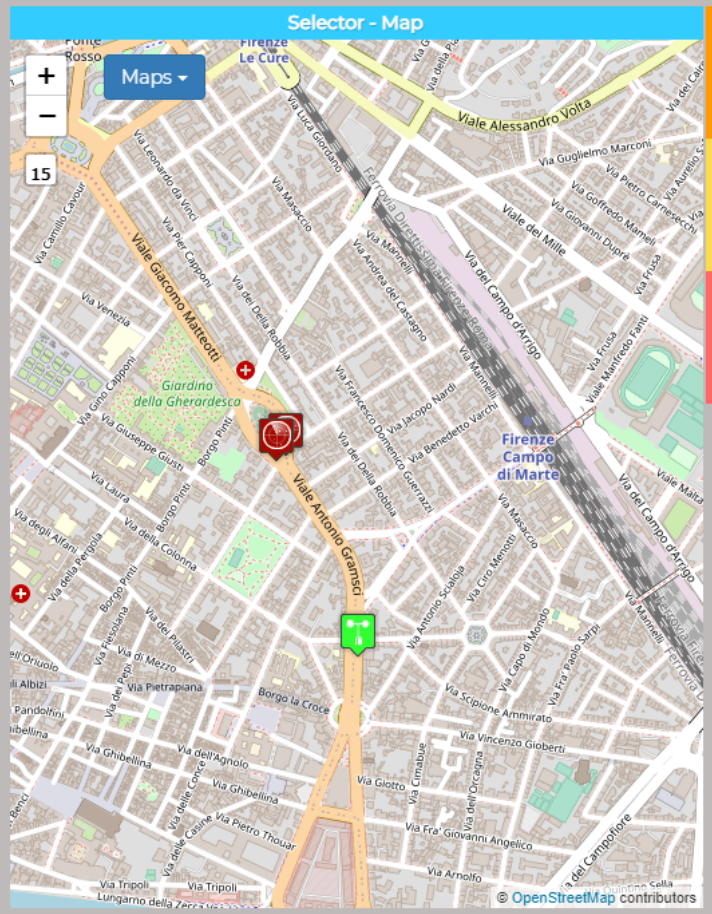
in ZTL yearly compare 9m



NOX reduction for COVID

Monitoraggio Area Gramsci: NO2 vs Traffico

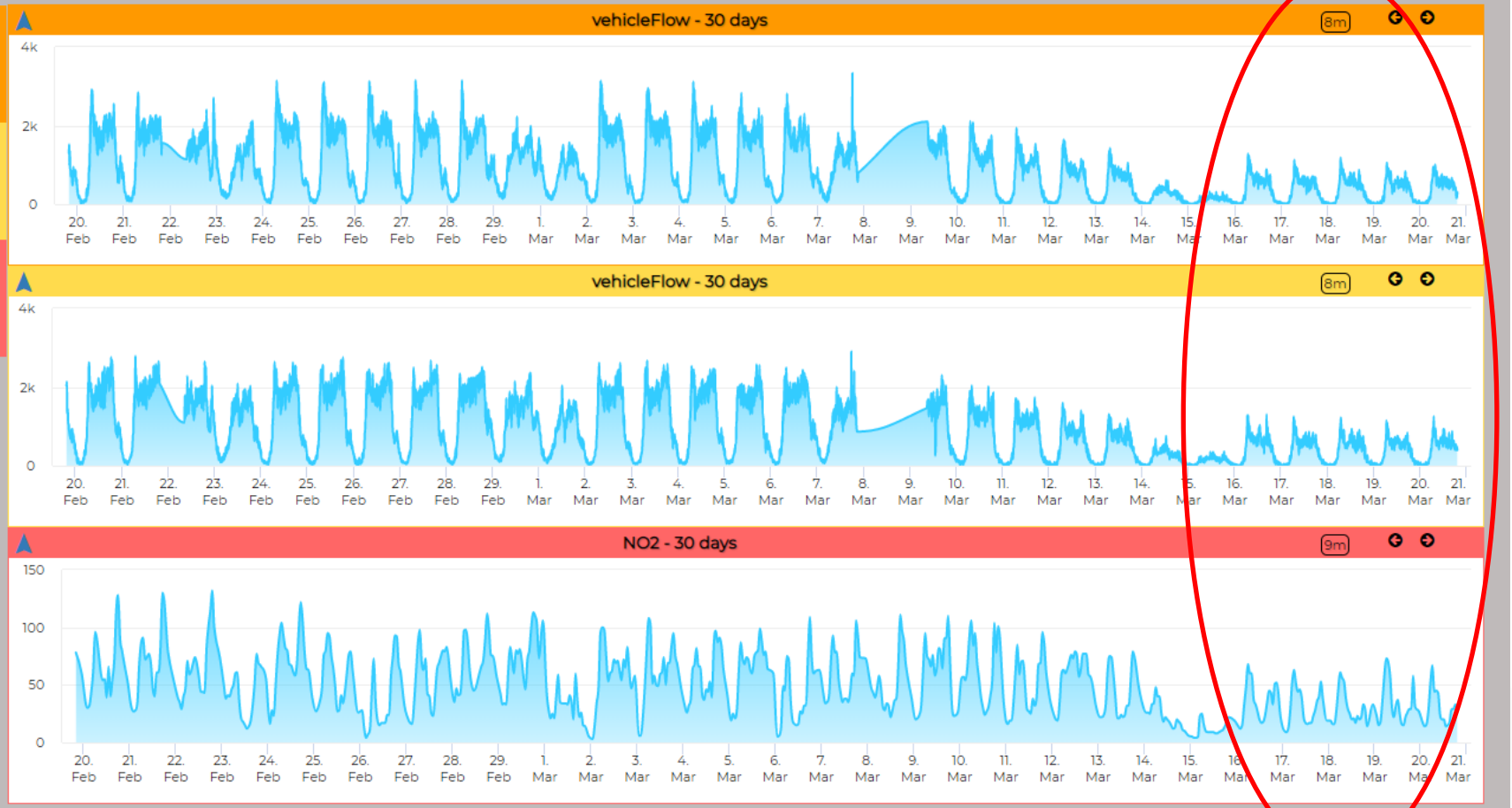
Sun 19 Apr 19:16:42



InOut traffic Firenze

NOX Predictions

Real Time Traffic



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjI4OQ==

Andamenti Nazionali e Regionali infezione COVID-19

Sulla base dei dati della protezione civile, elaborazioni DISITLab

Sun 19 Apr 19:21:39

per evidenziare gli andamenti di vostro interesse: eliminare le curve che non interessano selezionandole in legenda.
Alcuni dati in passato non sono pervenuti alla protezione civile

486	nuovi_att_positivi
108257	Attualmente_positivi
23660	deceduti
47055	dimessi_guariti

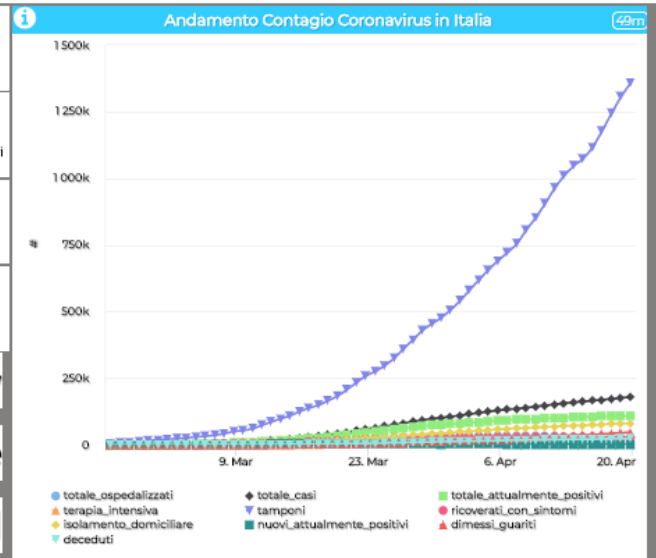
LOG view

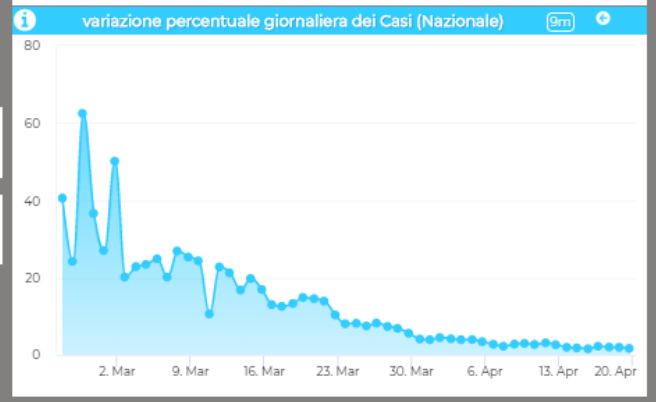
Mobile

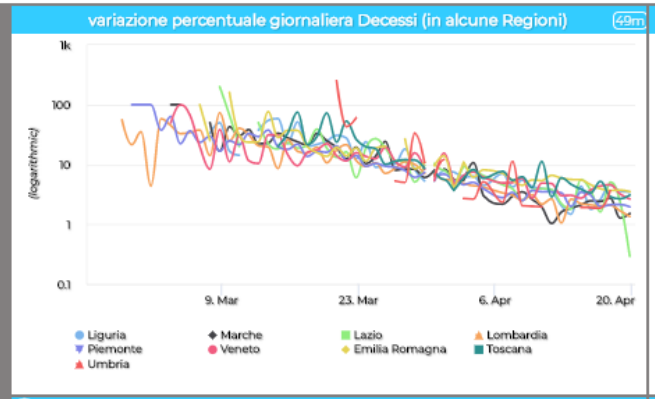
Staked

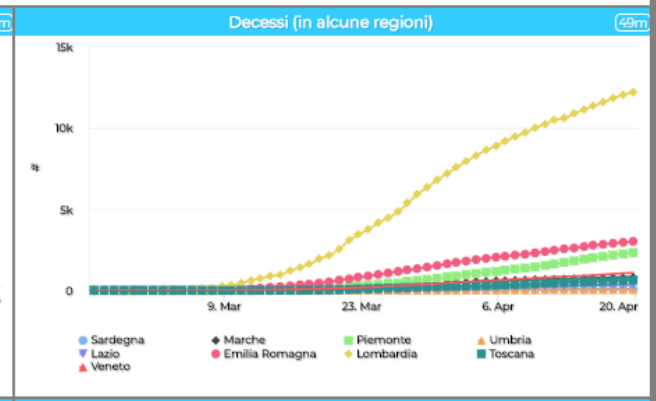
Regione Toscana

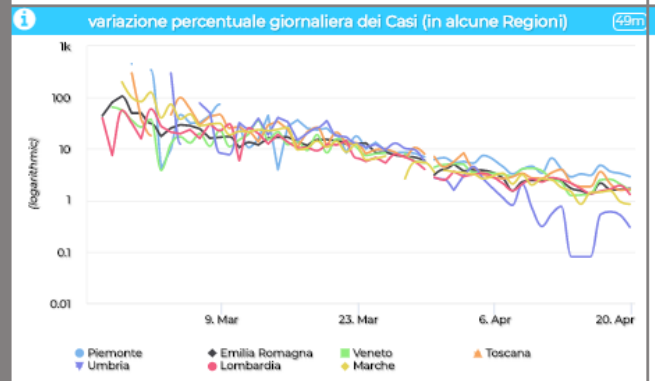
Regione LOG

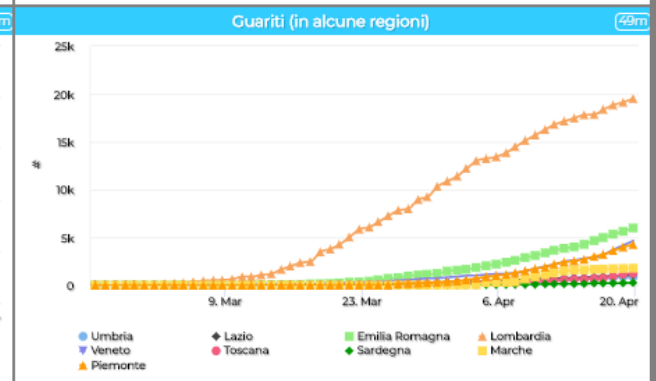


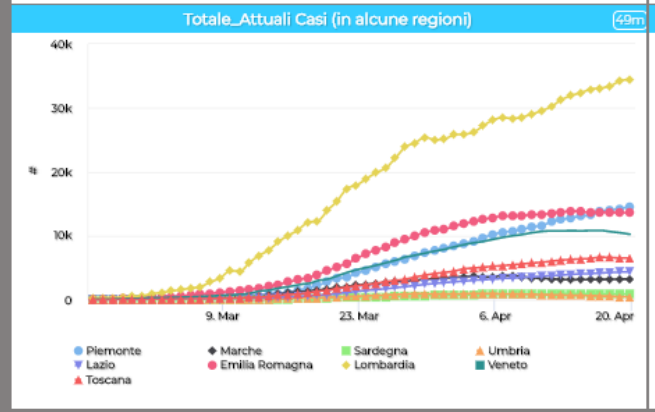


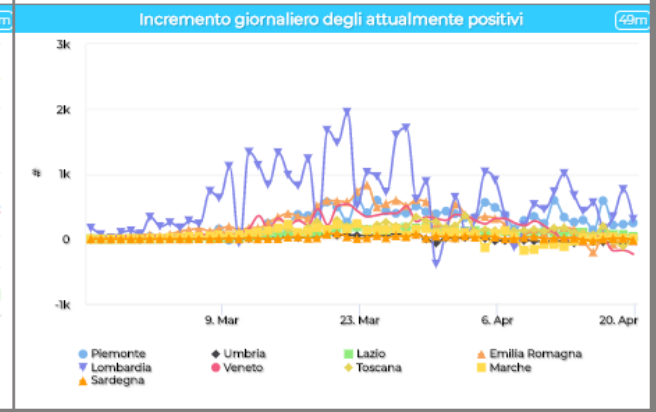












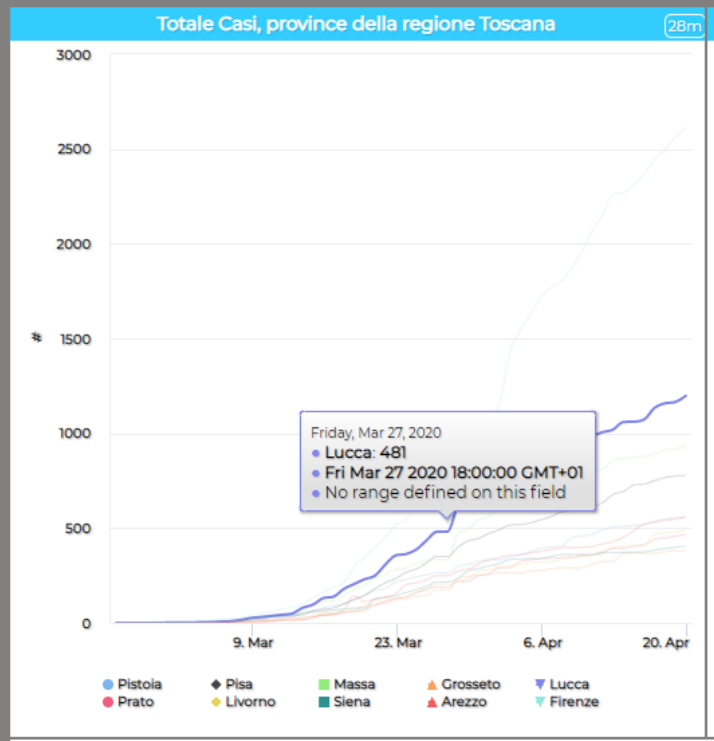
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU2OQ==

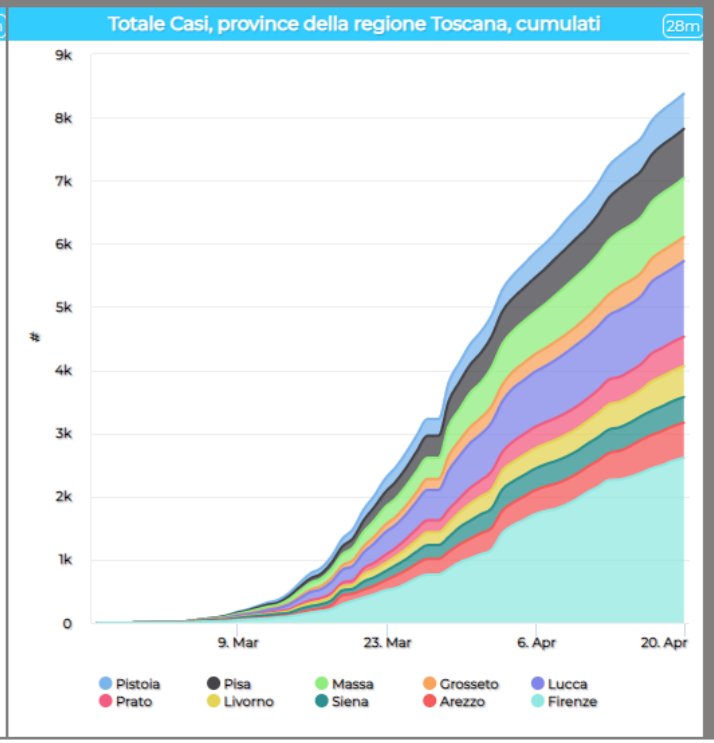
Main IT Provinces vs Tuscany Provinces: COVID-19

Andamento Regione Toscana e Province, COVID-19

Sulla base dei dati della protezione civile, elaborazioni DISITLab

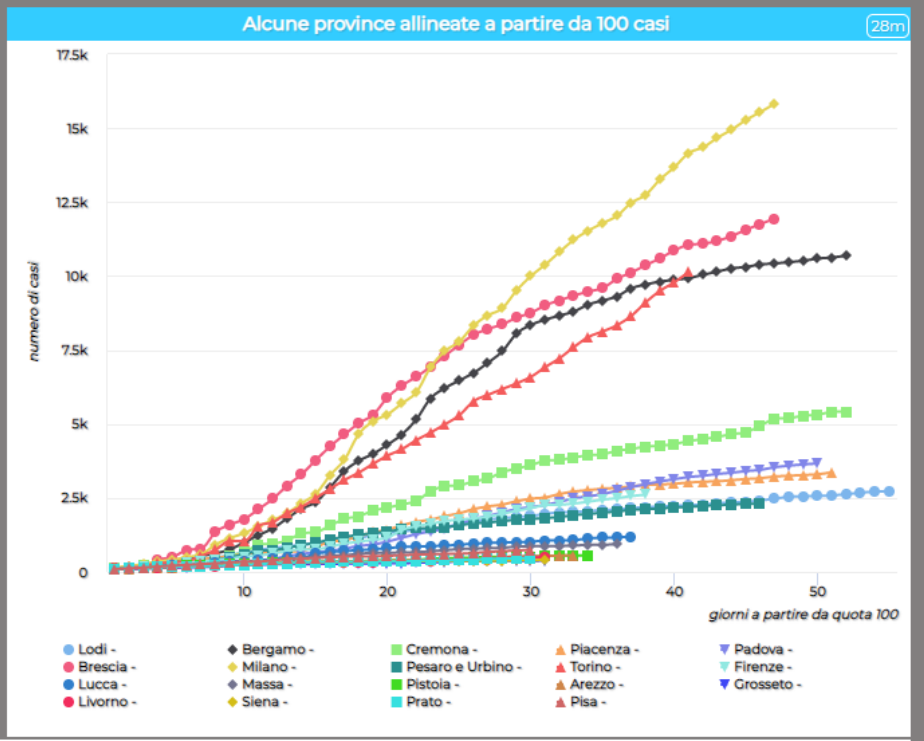
Sun 19 Apr 19:19:56





passa al Nazionale Regionale

Log view



per evidenziare gli andamenti di vostro interesse: eliminare le curve che non interessano selezionandole in legenda.

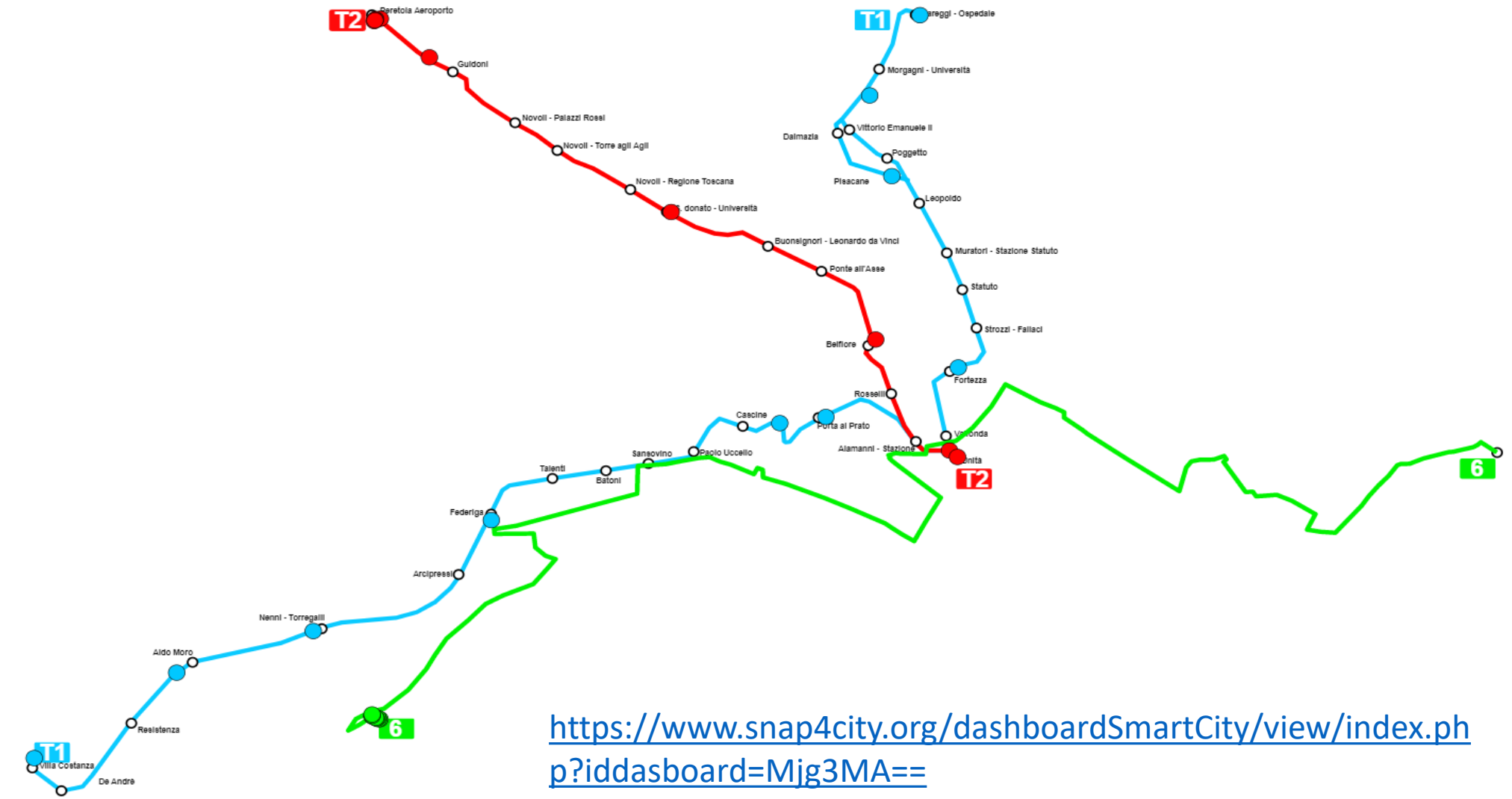
Alcuni dati in passato non sono pervenuti alla protezione civile

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU3NQ==

Firenze SVG Tramline Multi rides

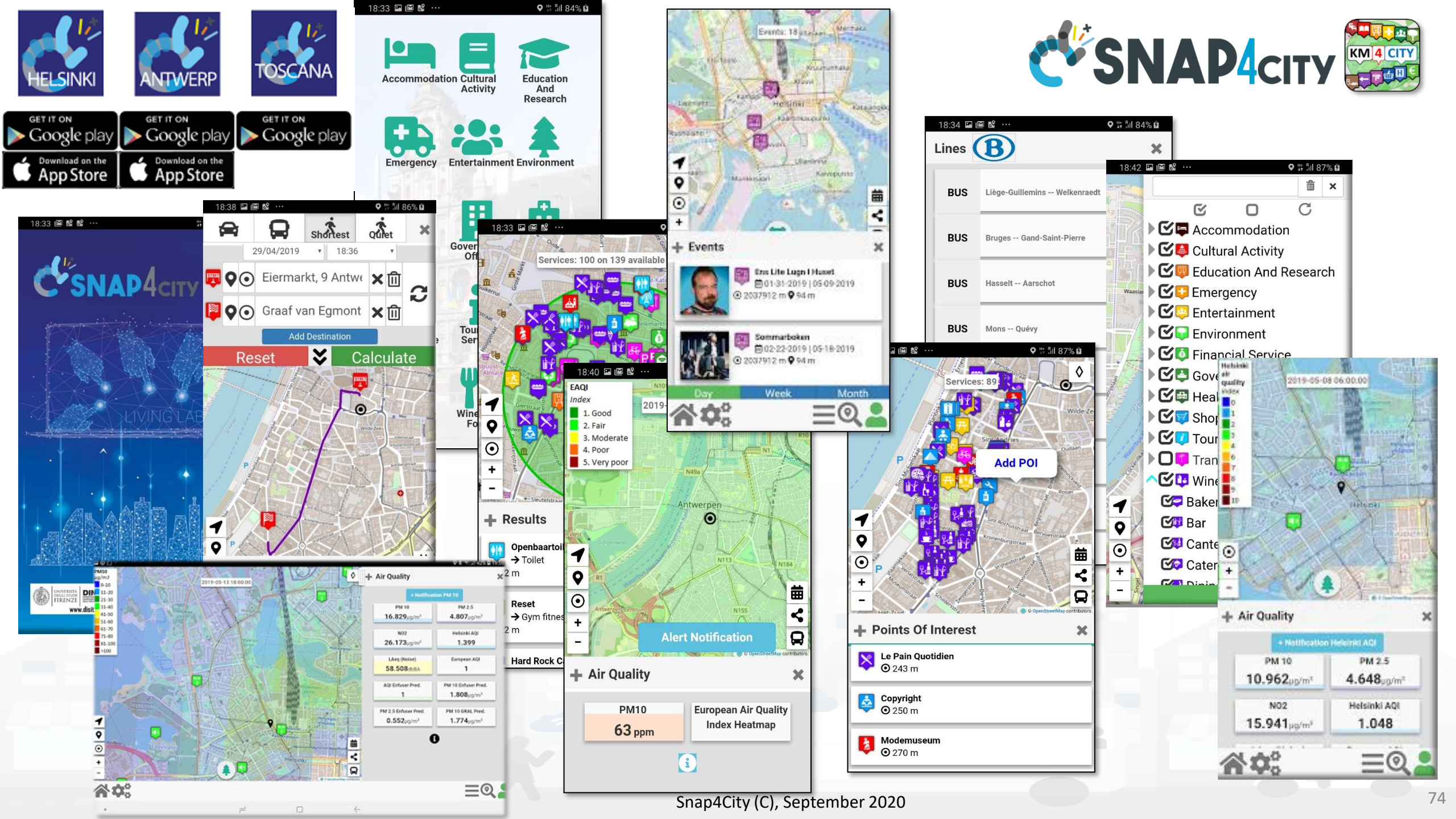
Fri 17 Jul 18:29:50

Tramline



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjg3MA==

Engaging City Users Towards Virtuous Behaviours (real time)

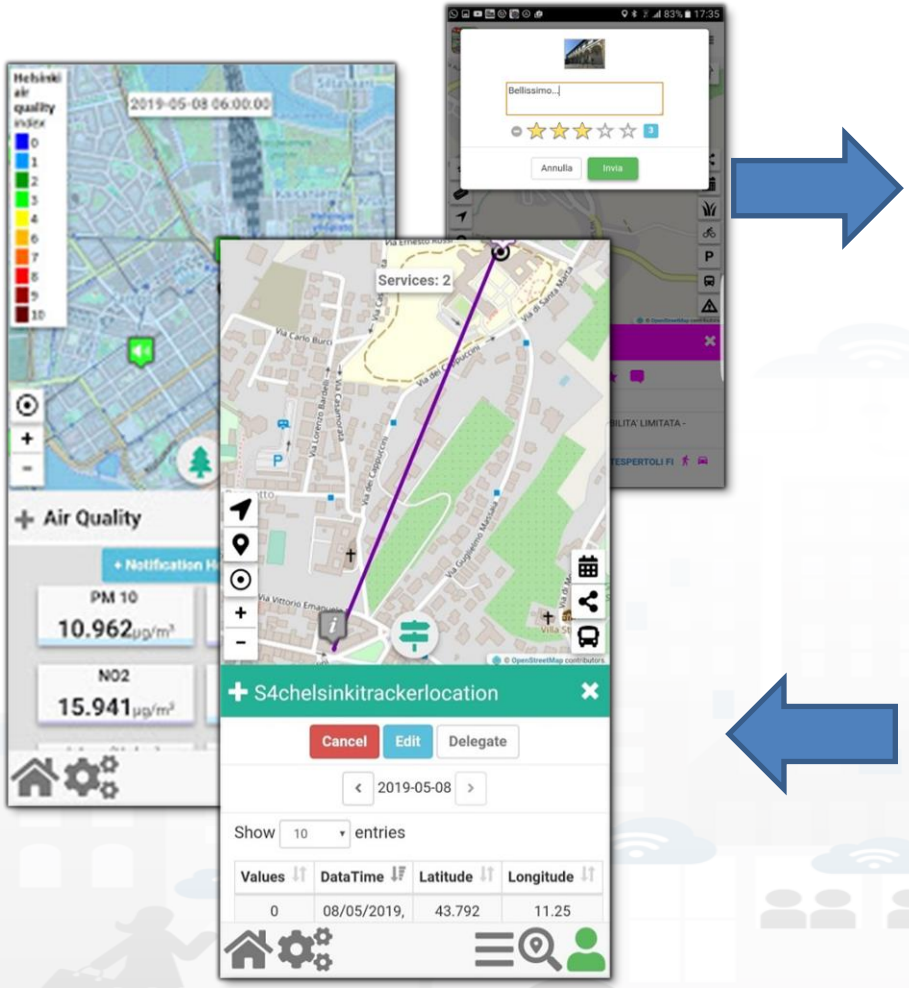

HELSINKI
ANTWERP
TOSCANA
GET IT ON Google play
Download on the App Store
SNAP4CITY
KM 4 CITY
Accommodation
Cultural Activity
Education And Research
Emergency
Entertainment
Environment
Shortest
Quiet
Add Destination
Reset
Calculate
Events
Day
Week
Month
Services: 100 on 139 available
EAQI
Index
1. Good
2. Fair
3. Moderate
4. Poor
5. Very poor
Results
Antwerpen
Alert Notification
Air Quality
PM10
63 ppm
European Air Quality Index Heatmap
Lines
BUS
Liège-Guillemins -- Welkenraedt
Bruges -- Gand-Saint-Pierre
Hasselt -- Aarschot
Mons -- Quévy
Add POI
Points Of Interest
Le Pain Quotidien
243 m
Copyright
250 m
Modemuseum
270 m
Financial Service
Bar
Air Quality
PM 10
10.962
PM 2.5
4.648
NO2
15.941
Helsinki AQI
1.048

The App is a Bidirectional Device

- GPS Positions
- Selections on menus
- Views of POI
- Access to Dashboards
- searched information
- Routing
- Ranks, votes
- Comments
- Images
- Subscriptions to notifications
- ….

Produced information

- Accepted ?
- Performed ?
- …



Derived information

- Trajectories
- Hot Places by click and by move
- Origin destination matrices
- Most interested topics
- Most interested POI
- Delegation and relationships
- Accesses to Dashboards
- **Cumulated Scores from Actions**
- Requested information
- Routing performed
- …..

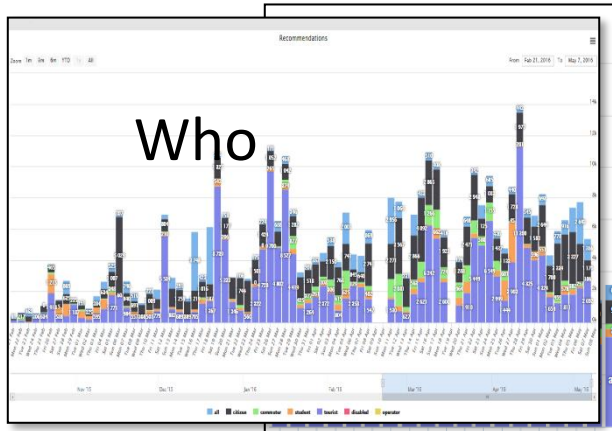
Produced information

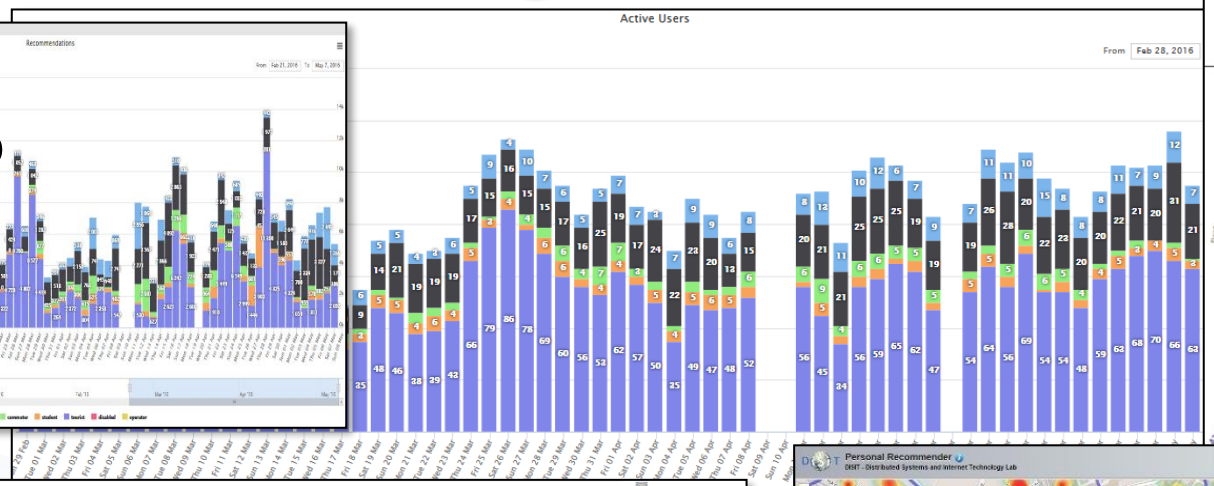
- Suggestions
- Engagements
- Notifications
- …

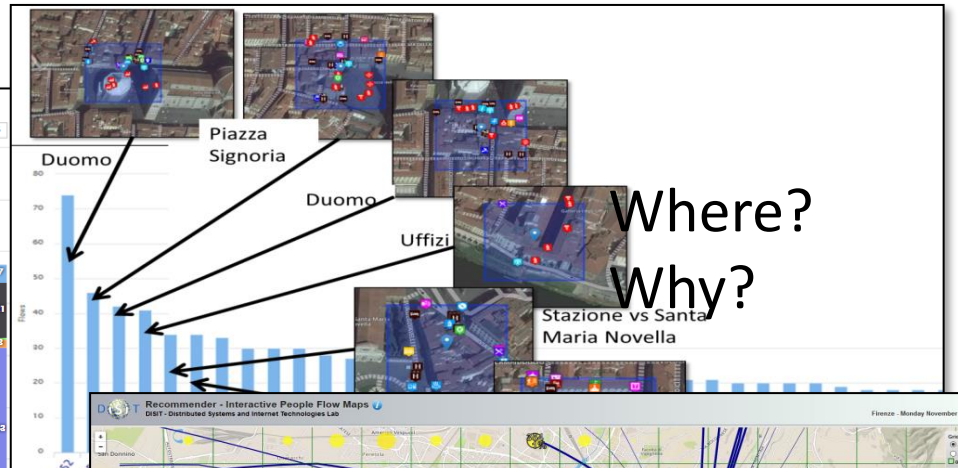
Users

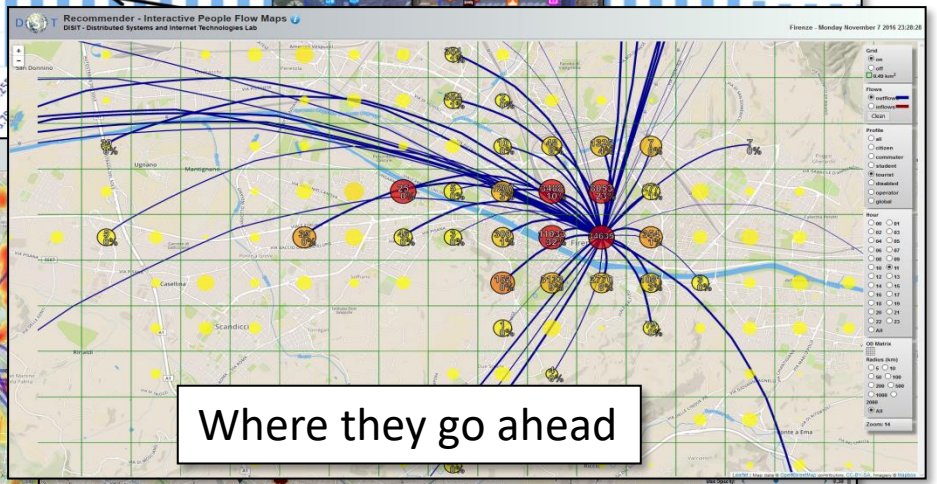
System

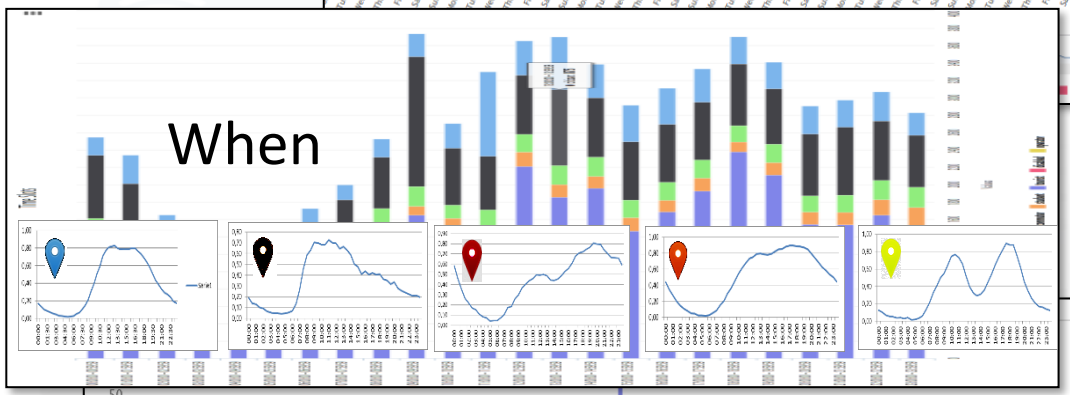
User Behavior Analyser for Collective Profiling

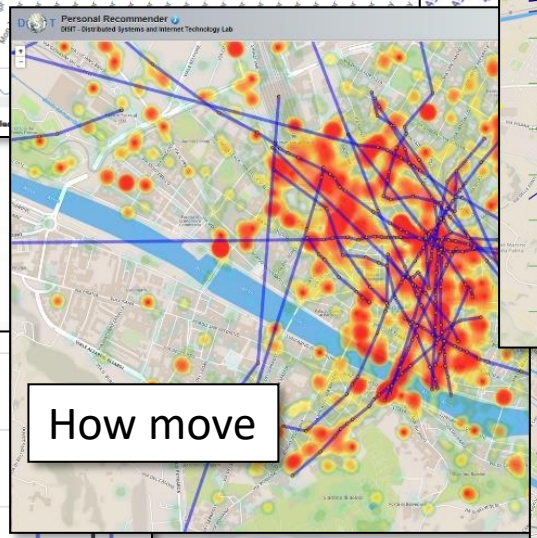


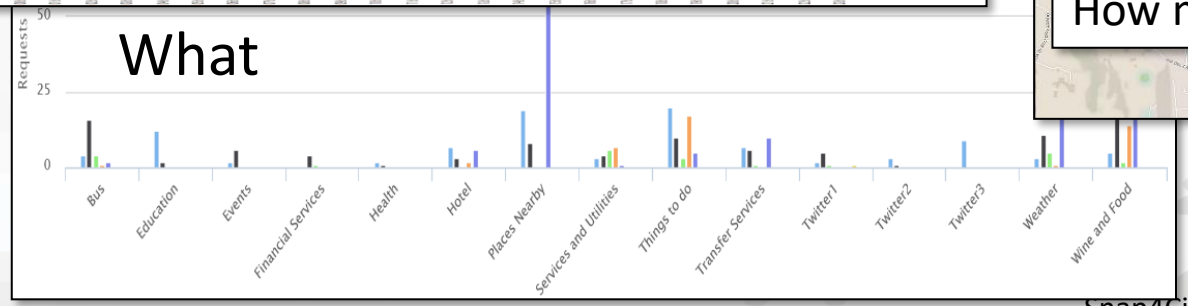


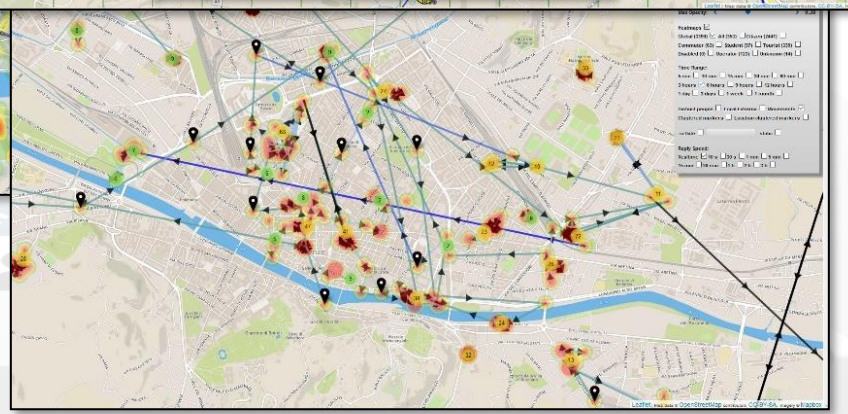




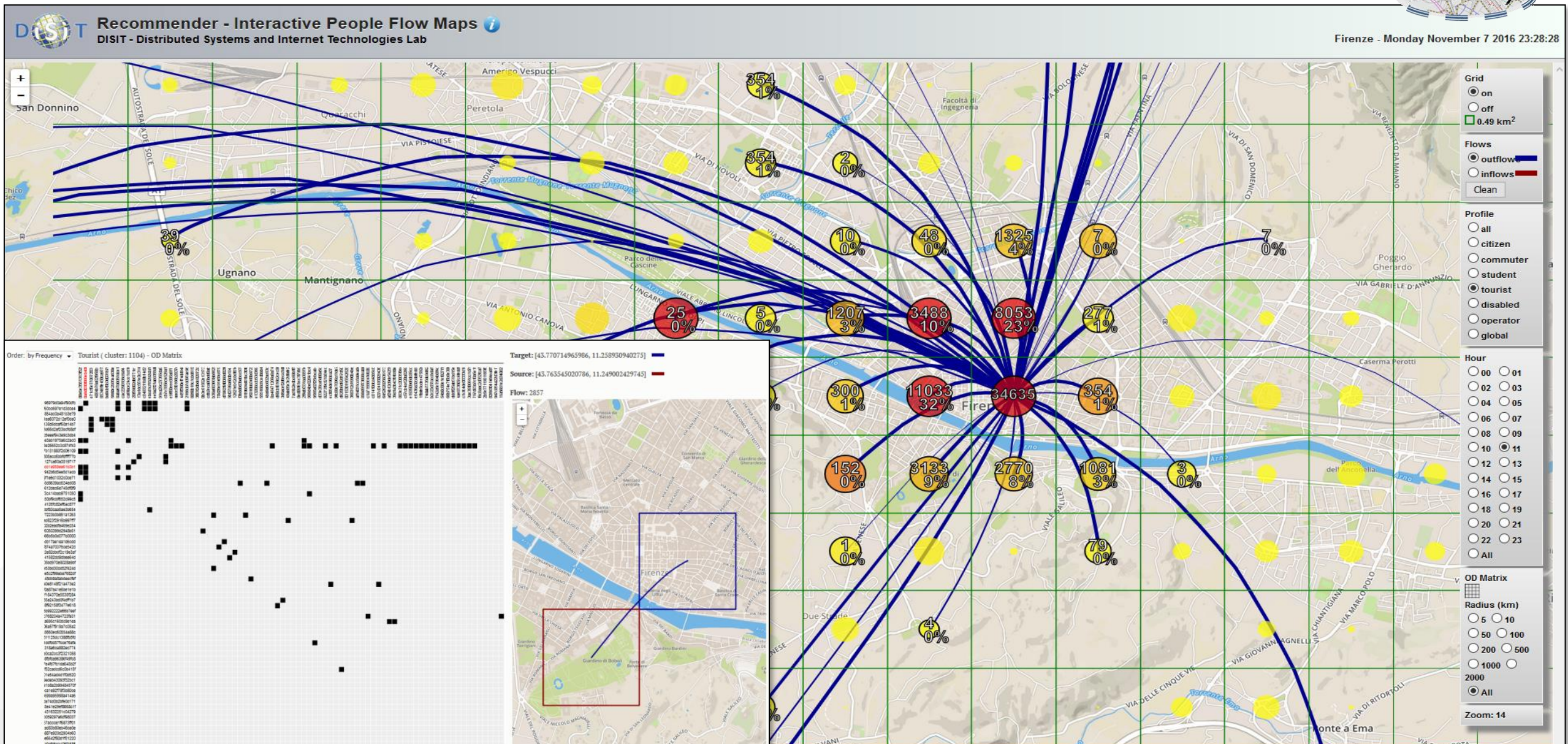






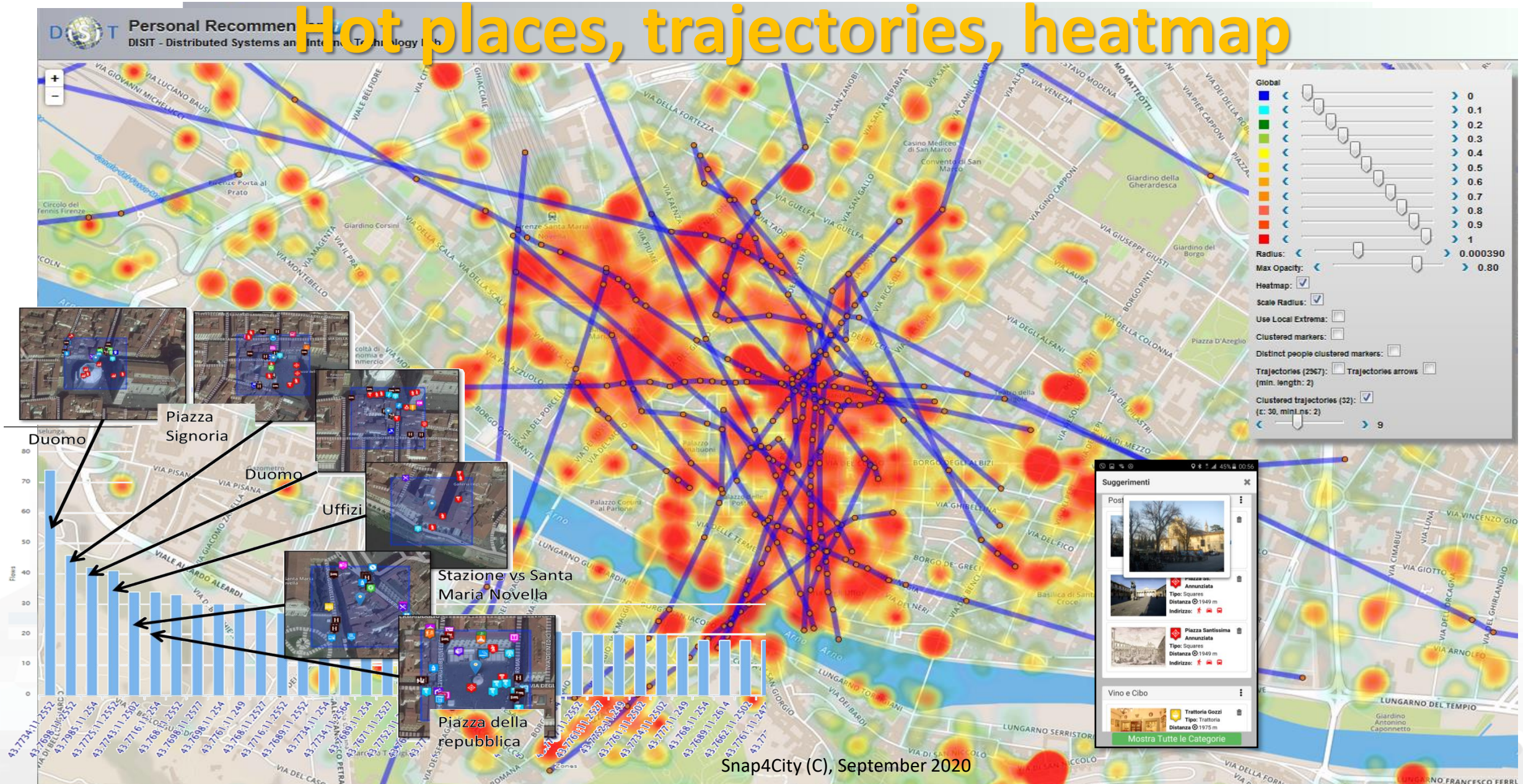


Scalable OD Matrix



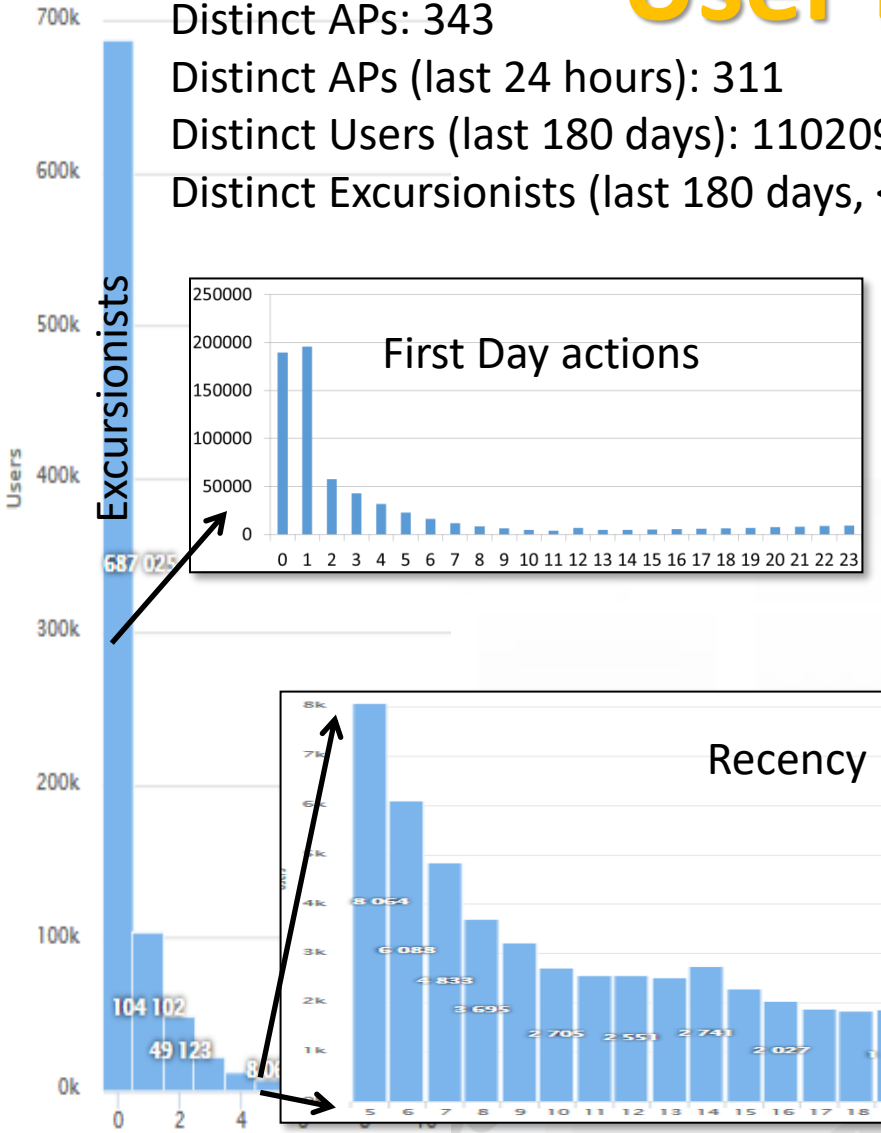
User Behaviour Analyser

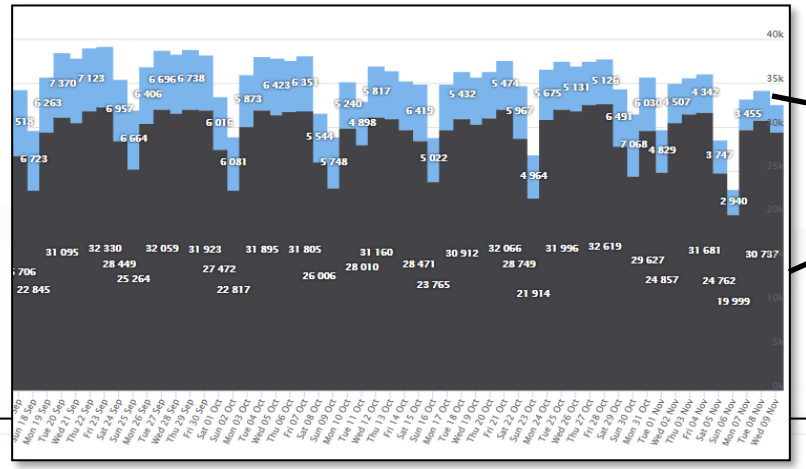
Hot places, trajectories, heatmap



User Behaviour Analysis

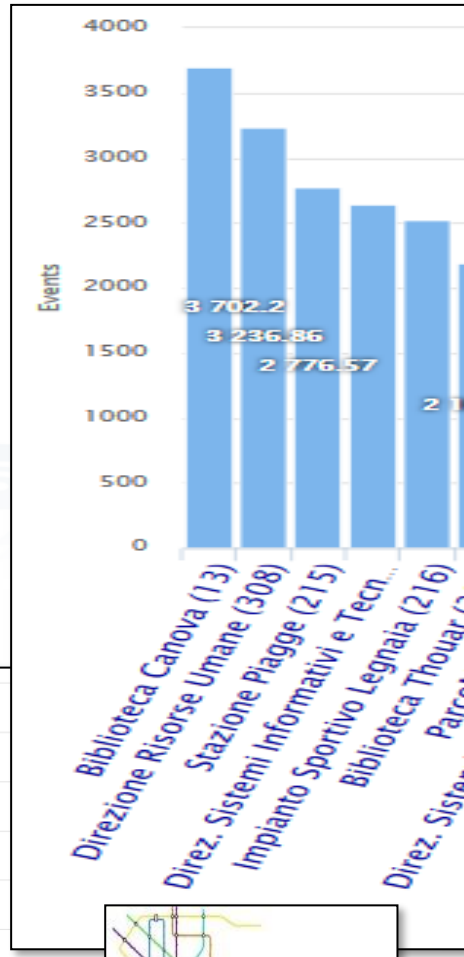
Distinct APs: 343
Distinct APs (last 24 hours): 311
Distinct Users (last 180 days): 1102098
Distinct Excursionists (last 180 days, < 24 h): 687025



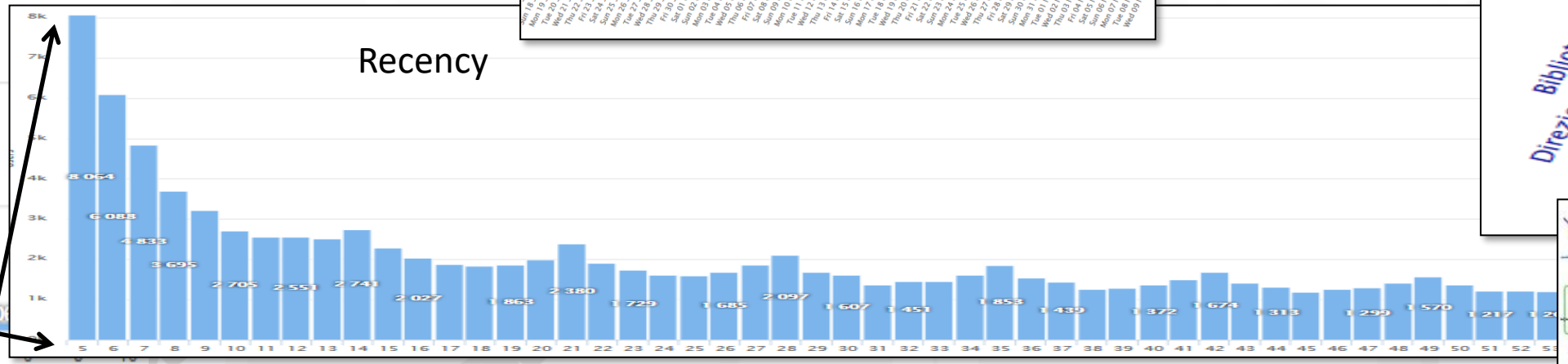


New City Users
VS
Returning

Where



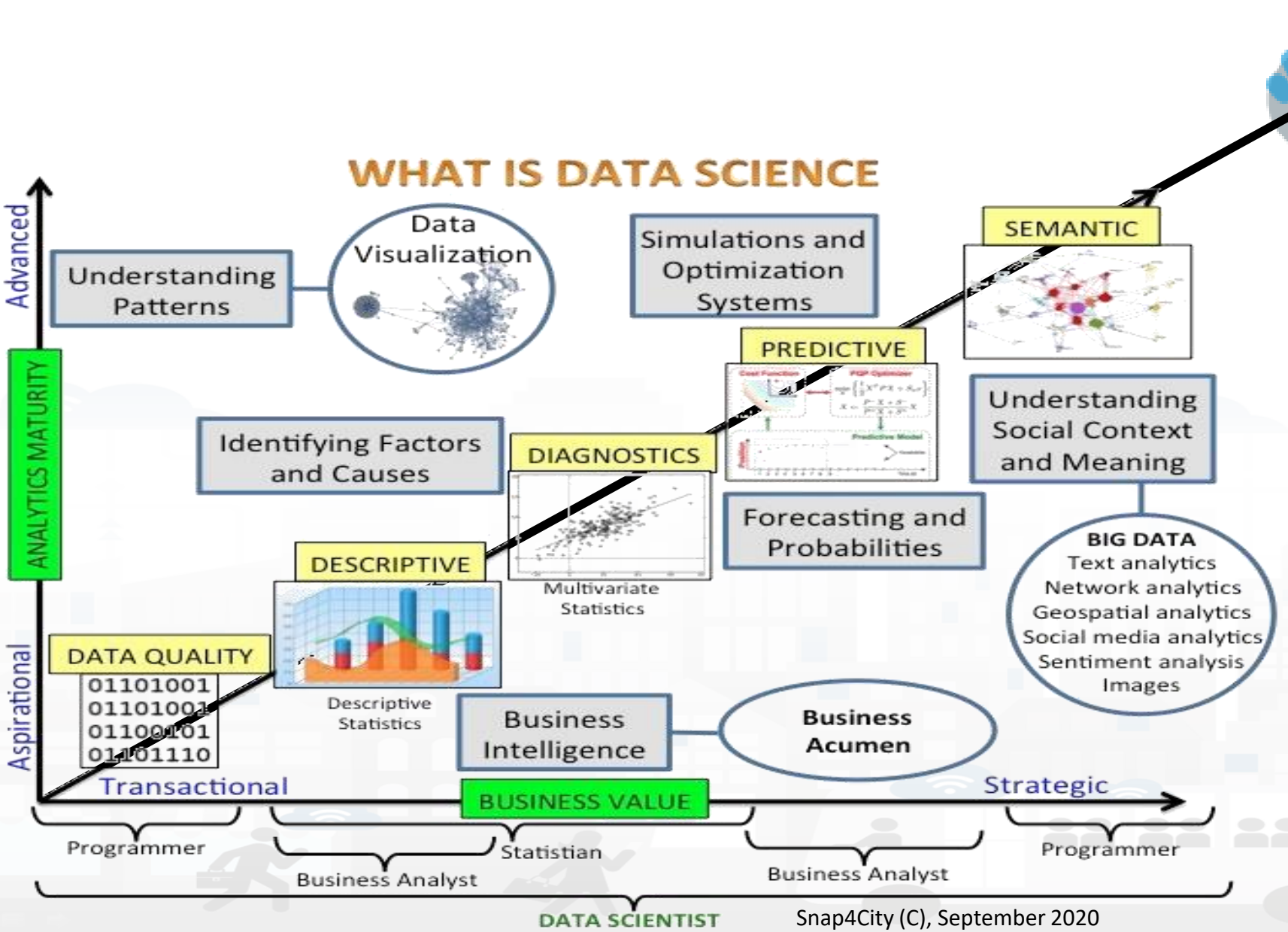
Recency



Campaing on Sustainable Mobility

TOP

DATA ANALYTICS, Big Data Science



Sentient and active processes

- Big Data
- Semantic Computing
- Machine Learning
- Geo Spatial Reasoning
- Sentiment Analysis
- What If Analysis
- Text Analysis
- Simulations
- Visual Analytics
- MicroServices
- Scalability
- Engagement Analysis
- ….

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

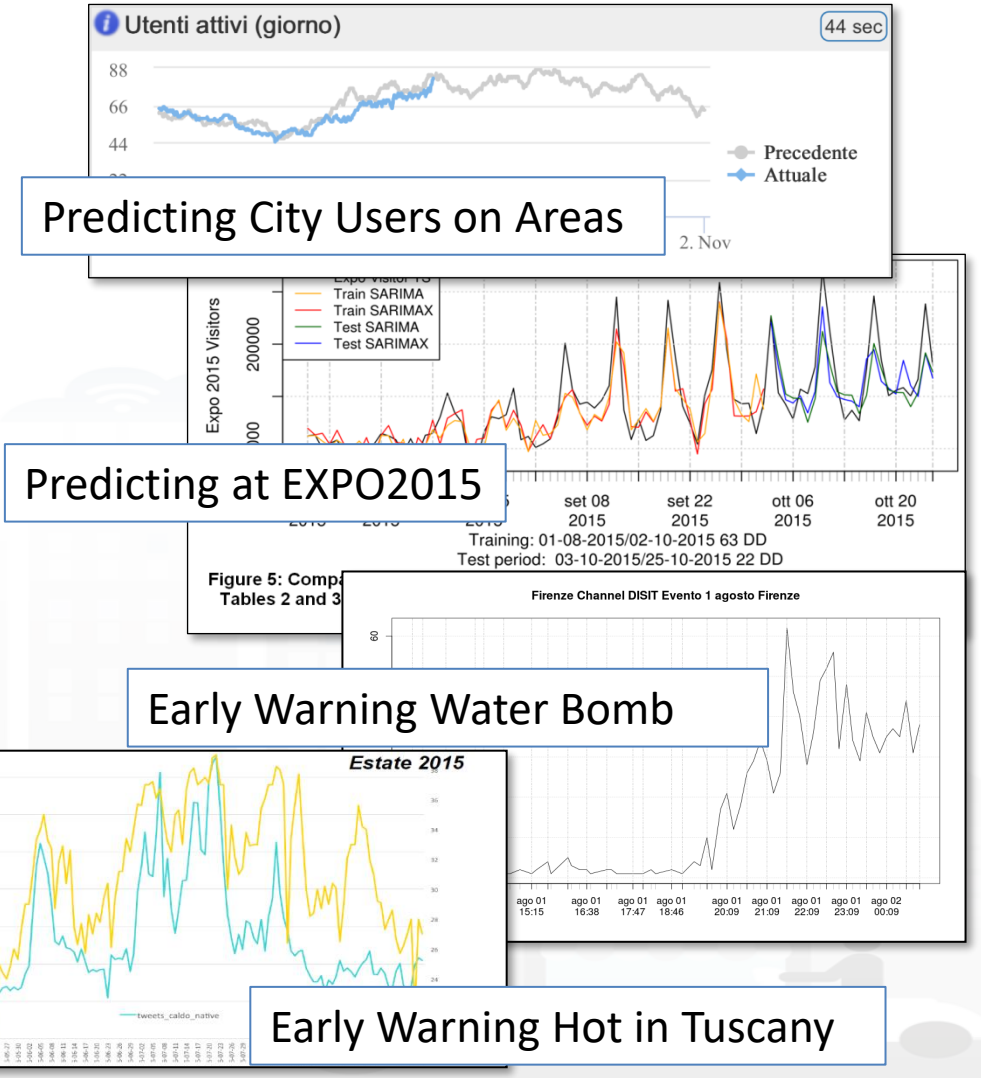
Disappearing Data Analytics

SNAP4CITY | KM 4 CITY

	Antwerp					Helsinki								Where				
SNAP4CITY	City official	ICT official	Developer	Citizen, tourist, visitor	Business owner	City officials	City officials Domain experts	City officials City developers	Third party developers	Citizen	Citizens with respiratory problems	Tourists	Business owners	Mobile	MicroApplication	Tool, via Portal (ICT Developers)	Dashboards	RULE OF THUMB Main Data Sources
Discovery near to me	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			POI, OSM
Discovery along a path	x	x	x	x		x		x	x	x	x	x		x	x			POI, OSM
Discovery in an area, shape	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		POI, OSM
browsing Public Transport	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			OSM, GTFS
Full Text search	x	x	x	x	x	x		x	x	x	x	x	x	x		x		POI, OSM
Routing: pedestrian				x	x			x	x	x	x	x	x	x	x			OSM
Routing: pedestrian quite				x	x			x	x	x	x	x	x	x	x			OSM
Routing: private vehicles	x		x	x		x		x	x	x	x	x		x	x			OSM
Routing: Multimodal Public Transport				x					x	x	x	x		x	x	x		OSM, GTFS
heatmaps: weather (Temp, Humidity)	x	x		x	x	x	x		x	x	x	x	x	x			x	Sensors data, OSM
heatmaps: environmental variables, PM10, PM2.5, NO2, EAQI	x	x		x	x	x	x		x	x	x	x	x	x			x	Sensors data, OSM
heatmaps: environmental variables, Noise						x	x		x	x	x	x	x	x			x	Sensors data, OSM
heatmaps: safe on bike (Antwerp)	x	x		x	x									x			x	Spec. Portal
heatmaps: Enfuser prediction, PM10, PM2.5, AQI						x	x		x	x	x	x	x	x			x	Enfuser data
heatmaps piking values any place	x	x			x	x	x	x	x				x				x	Computed Heatmps
heatmaps: GRAL prediction, PM10						x	x		x	x	x	x	x	x			x	OSM, Traffic, Weather
Comparsison: Enfuser, Gral, Real Time						x	x										x	Enfuser, Sensors, GRAL
Sensors Data Time Trends, & drill down	x	x	x		x	x	x	x					x			x	x	Sensors data, OSM
Weather Forecast	x	x		x	x	x	x		x	x	x	x	x	x			x	Forecast Service
Origin Destination Matrices	x	x	x		x	x	x	x	x				x				x	Snap4City Mobile App
Typical trajectories	x	x	x	x	x	x	x	x	x				x			x	x	Snap4City Mobile App
Hot Area in the city	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	Snap4City Mobile App
Hot Places in Smart Zone	x	x	x	x	x									x		x	x	Snap4City PAXcounters
Services Suggestions on mobiles				x						x	x	x		x	x			Snap4City Mobile App
Alerts on critical cases: several variables	x			x	x	x	x			x	x		x	x				Sensors data, OSM
The most used services		x		x	x		x			x	x	x	x				x	Snap4City Mobile App
Twitter Trends Daily	x	x	x		x	x	x	x	x				x			x	x	Twitter Vigilance
The auditing of user and living lab		x				x		x								x		Snap4City Portal
Self assessment	x	x	x	x	x	x	x	x	x	x	x	x	x			x		Snap4City Portal
Trajectories reg from mobile PAX Counters	x	x	x			x	x	x							x		x	PAX Counters

Predicting Models for Administrators & City Users

- **Aiming at improving**
  - quality of service, distributing workload
  - early warning
- **Predictions**: **Short** (15 min, 30 Min) and mid Term (1 week)
- **Data Analytics**: ML, NLP/SA, Clust., …
  - Traffic Flows → multi-flow reconstruction
  - Parking Status → free slots
  - Environmental Alarms
  - Air Quality parameters and indexes
  - People Flows (Wi-Fi, Twitter)
    → crowd , #number of people



Free Parking Predictions

Careggi car park			
Model features	BRNN model results		
	R-squared	RMSE	MASE
Baseline	0.974	24	1.87
Baseline + Weather	0.975	24	1.75
Baseline + Traffic sensors	0.975	24	2.04
Baseline + Weather + Traffic sensors	0.975	24	1.87

Active on Mobile Apps as:

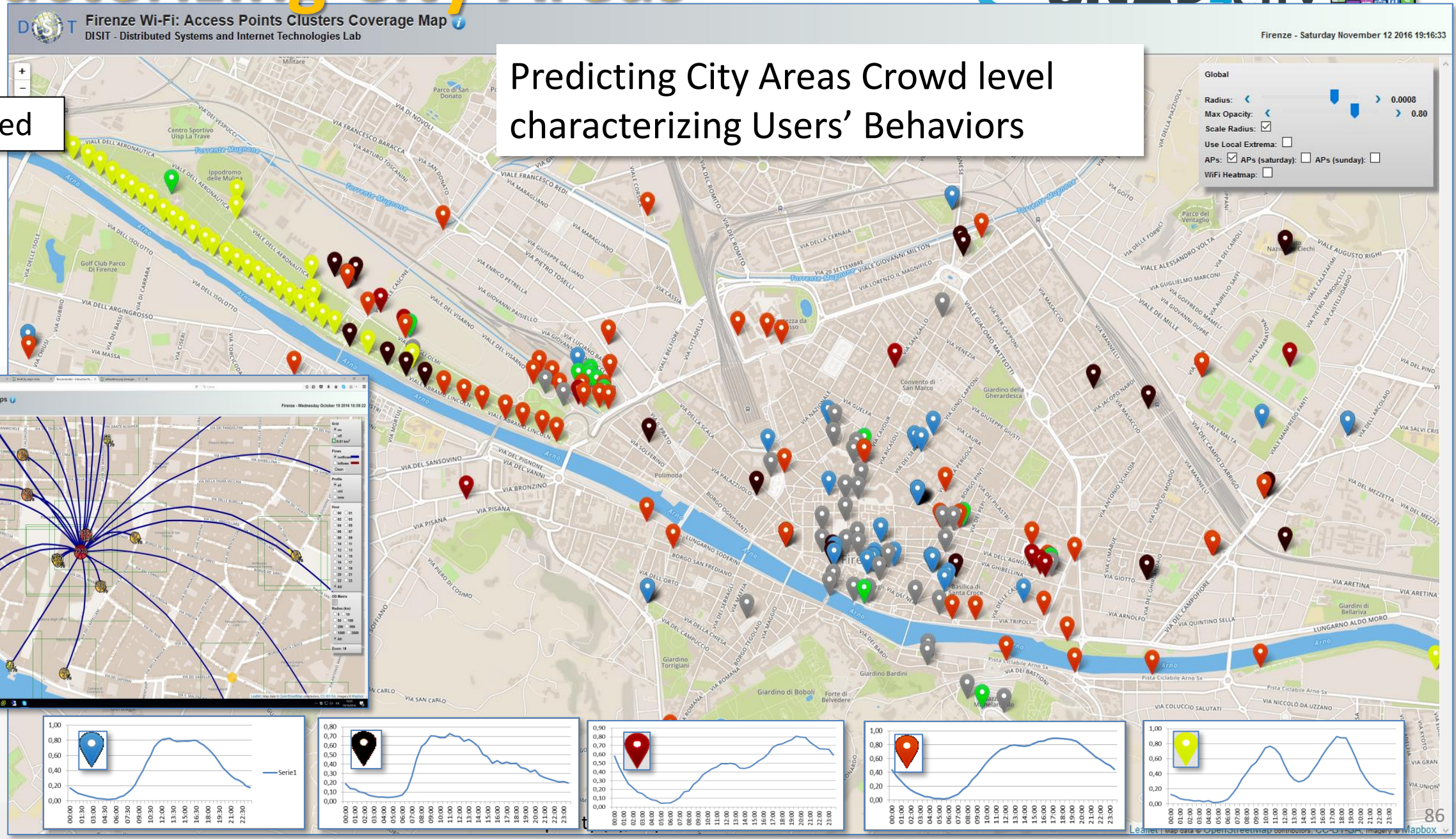
- «Firenze dove cosa»
- «Toscana dove cosa»

Precision: 97,5%

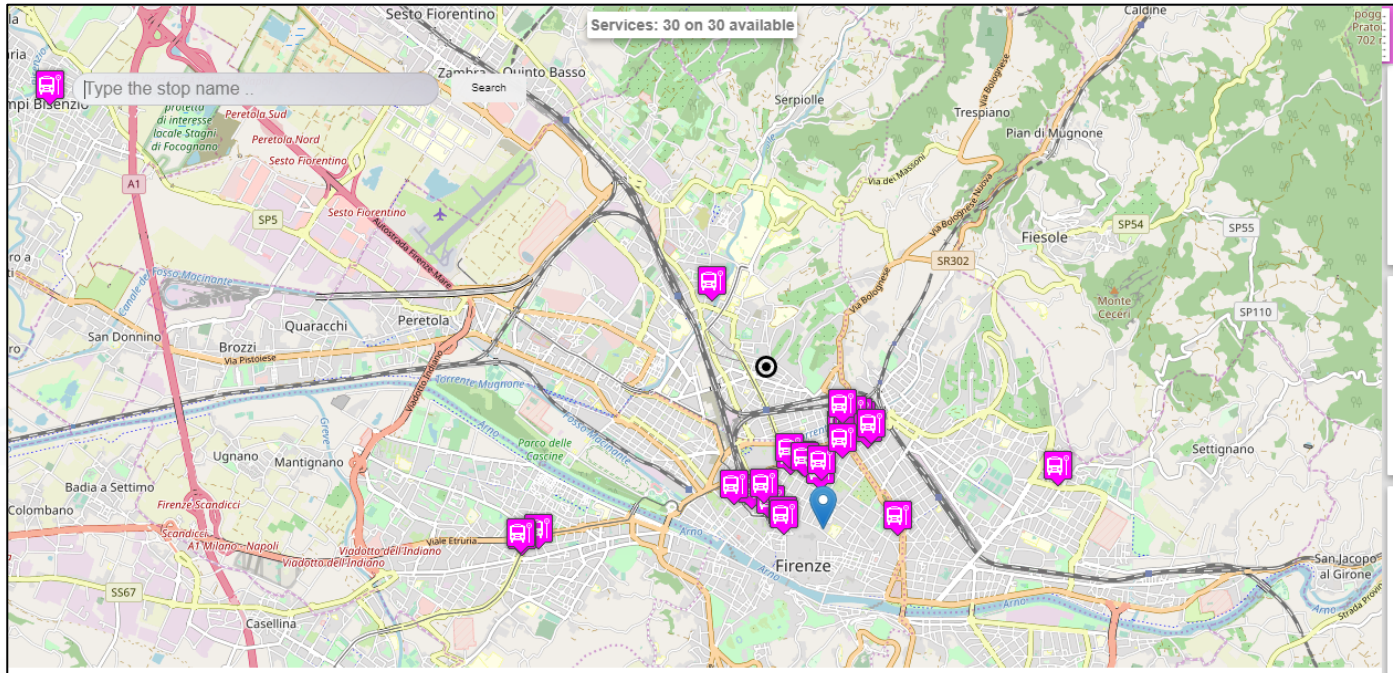
Characterizing City Areas

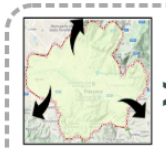
Wi-Fi based

Predicting City Areas Crowd level characterizing Users' Behaviors



Bus Stop Analysis: identification of criticalities





> 42300

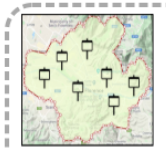
Daily individual Production Trips

> 52900

Daily Individual Attraction Trips

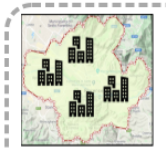
21289

Daily bus trips



1875

Bus Stops

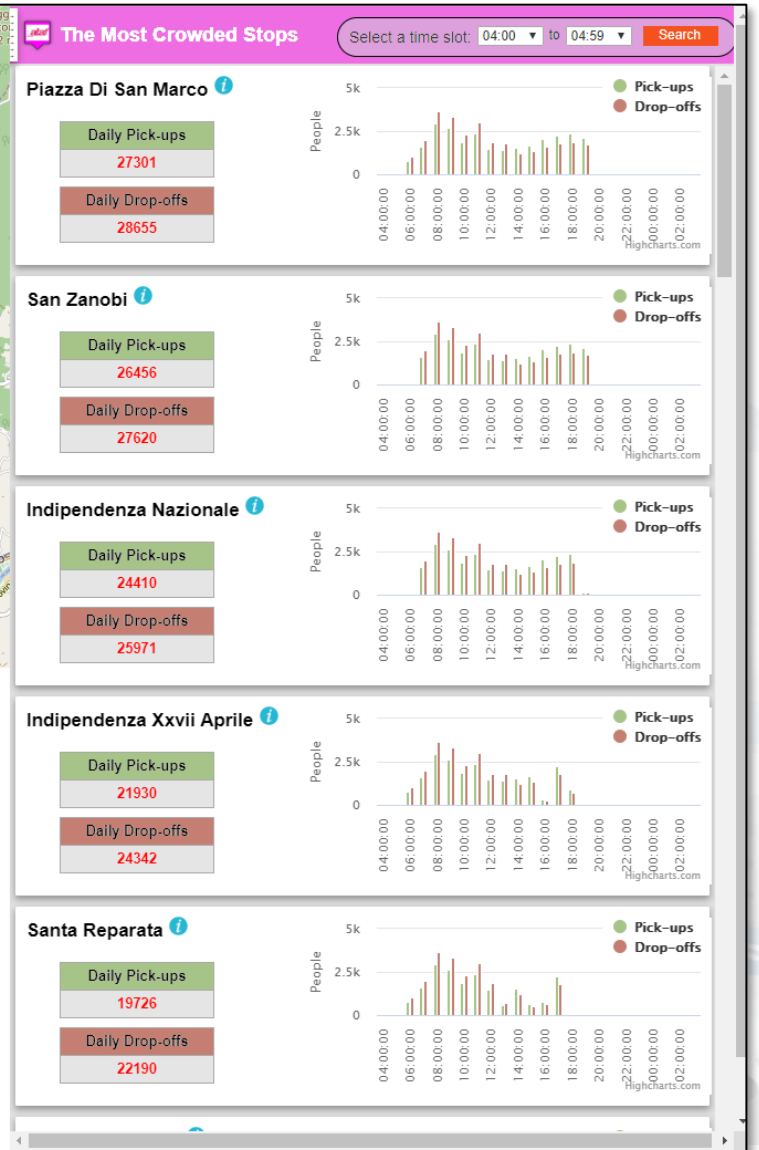


31070

Residential Buildings

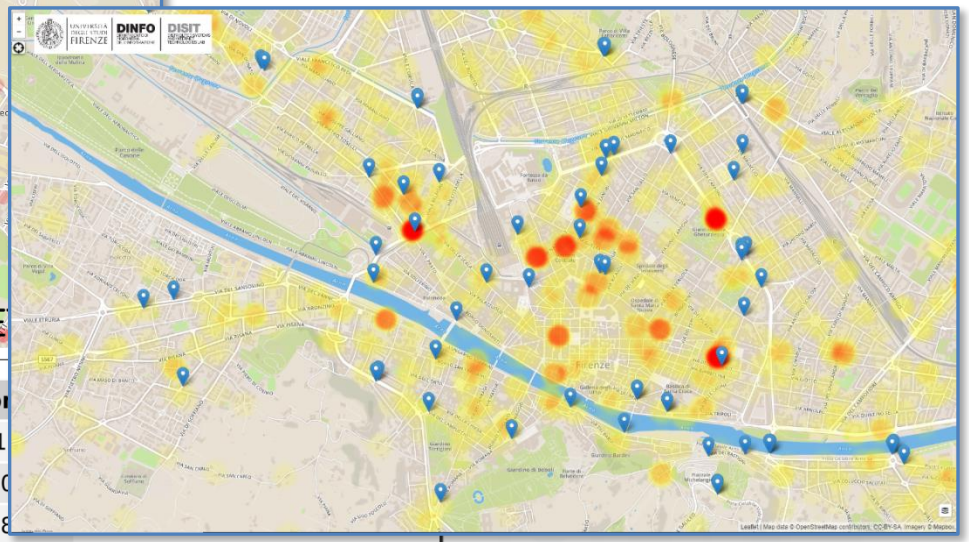
31059

Service Providers

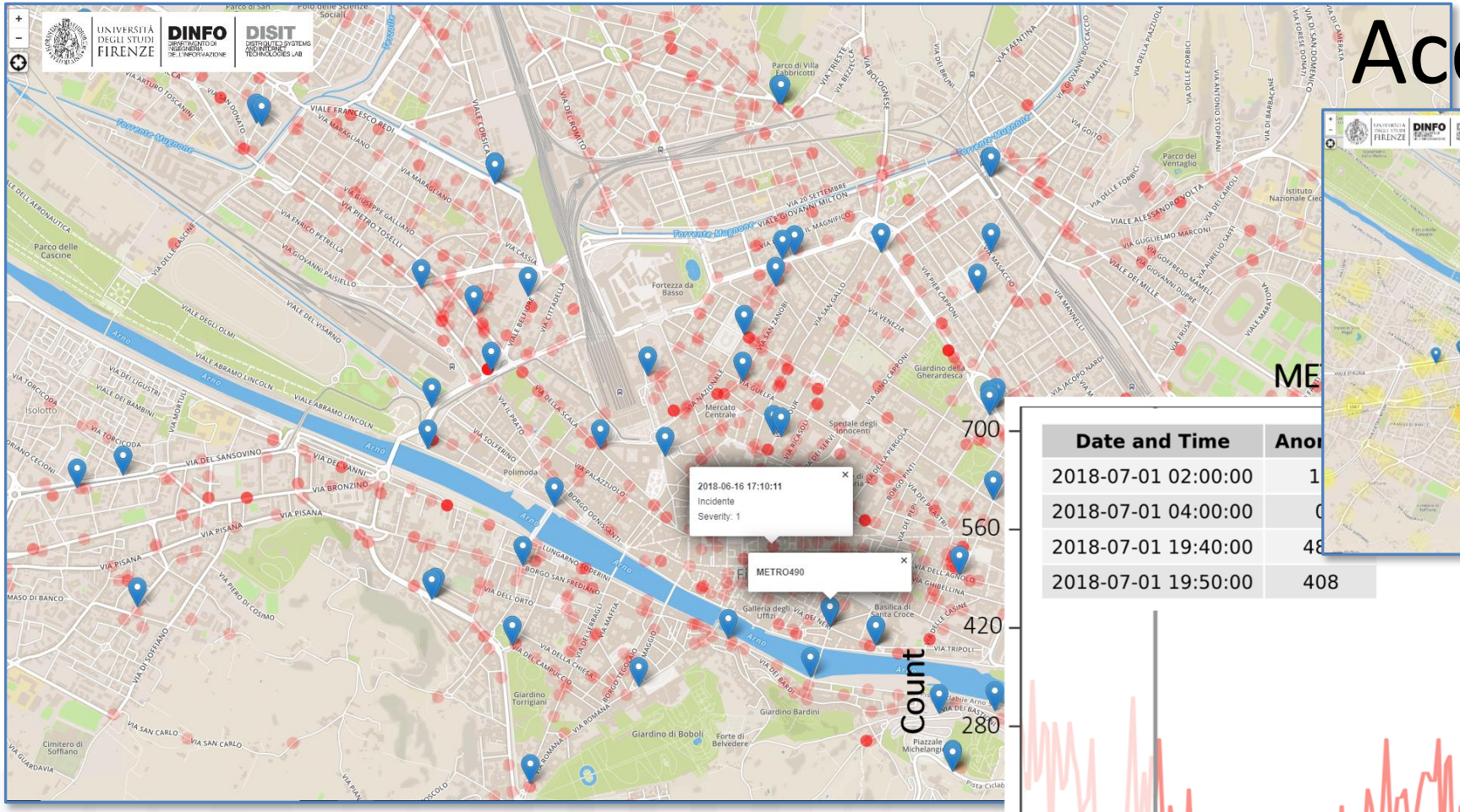


Anomaly Detection

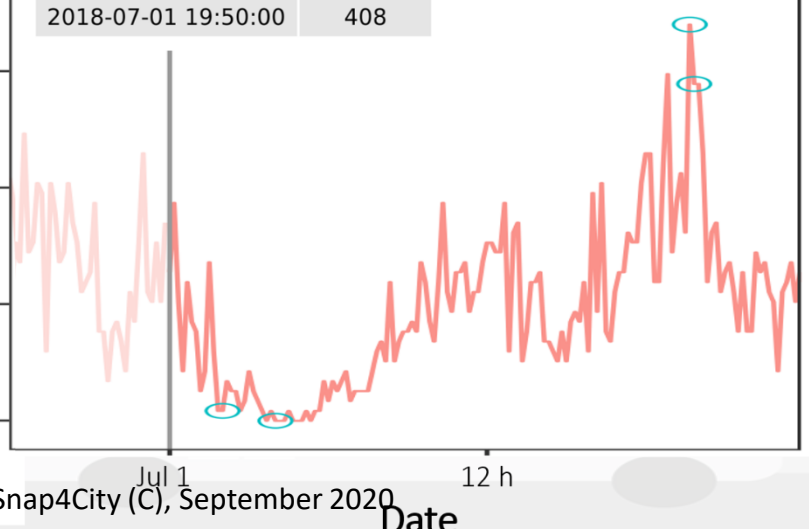
Accidents Density



Accidents vs Traffic

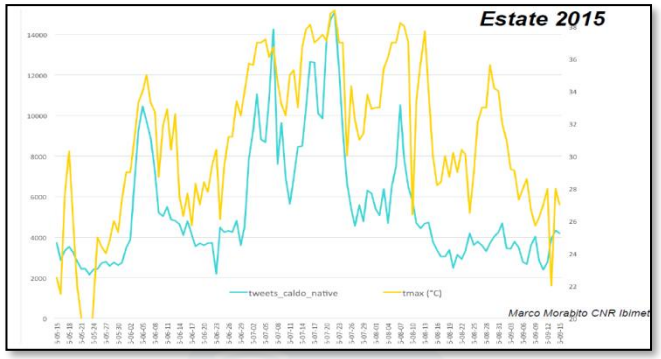


Date and Time	Ano
2018-07-01 02:00:00	1
2018-07-01 04:00:00	0
2018-07-01 19:40:00	48
2018-07-01 19:50:00	408



Prediction/Assessment

- Football game results as related to the volume of Tweets
- Number of votes on political elections, via sentiment analysis, SA
- Size and inception of contagious diseases
- marketability of consumer goods
- public health seasonal flu
- box-office revenues for movies
- places to be visited, most visited
- number of people in locations like airports
- audience of TV programmes, political TV shows
- weather forecast information
- Appreciation of services



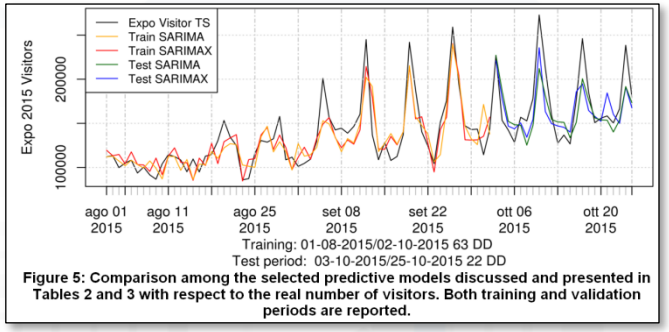
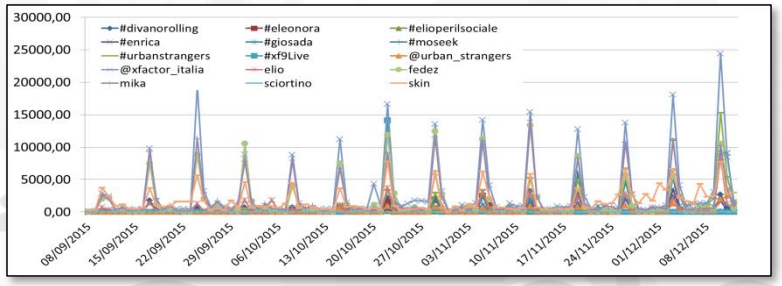
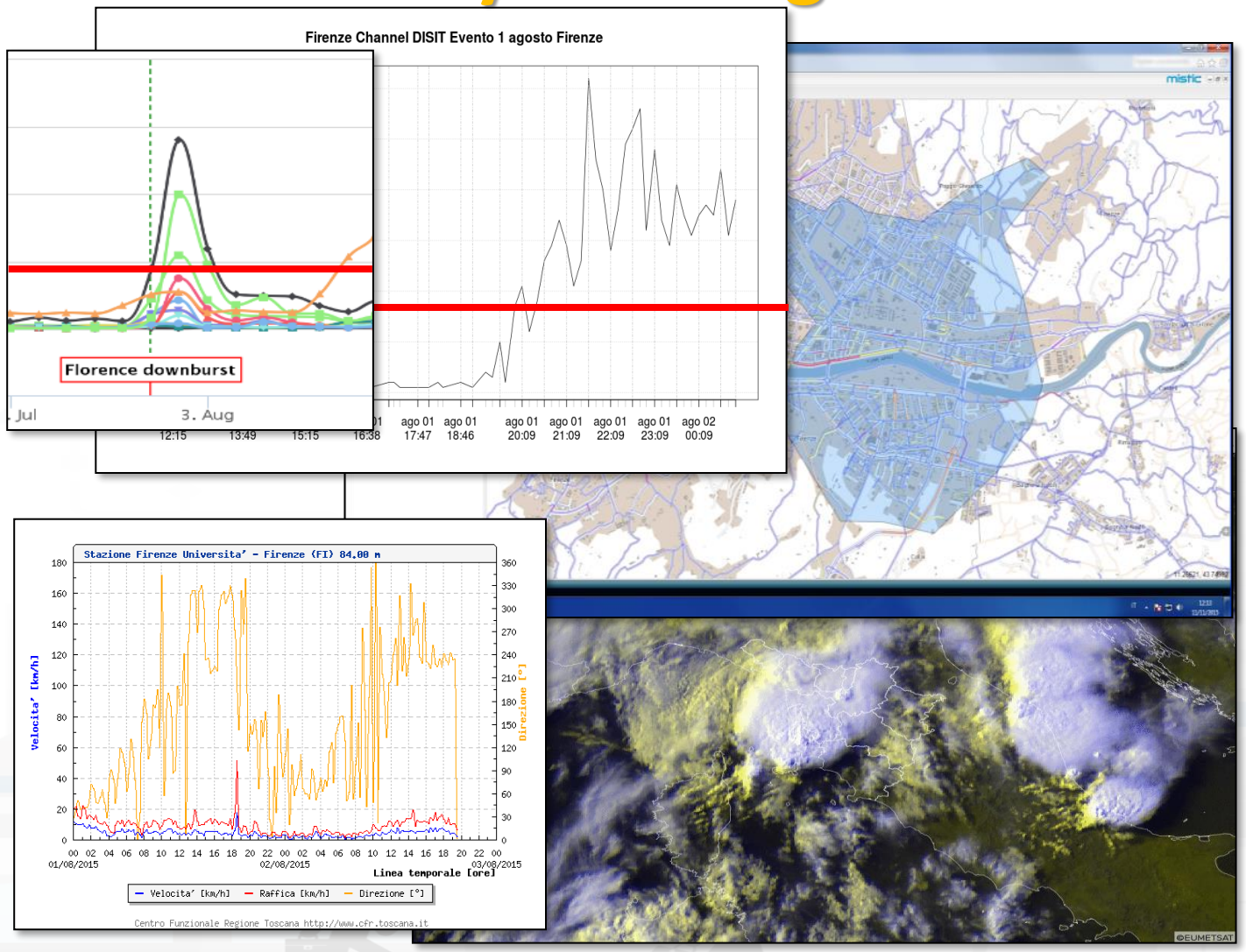


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.

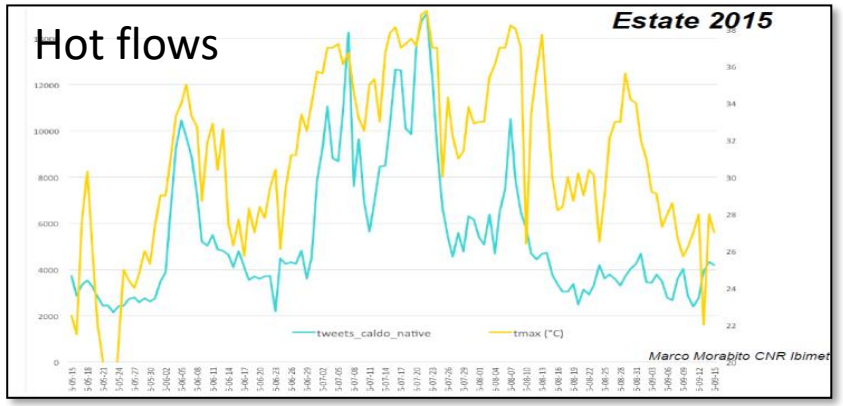


Twitter Vigilance

Early Warning



Predictive models



Attendance at long lasting events: EXPO2015

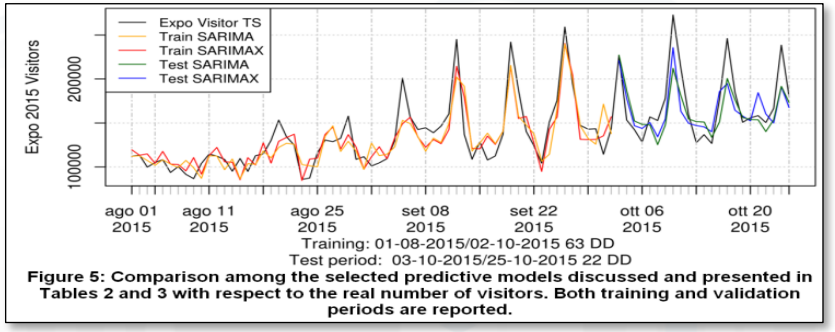
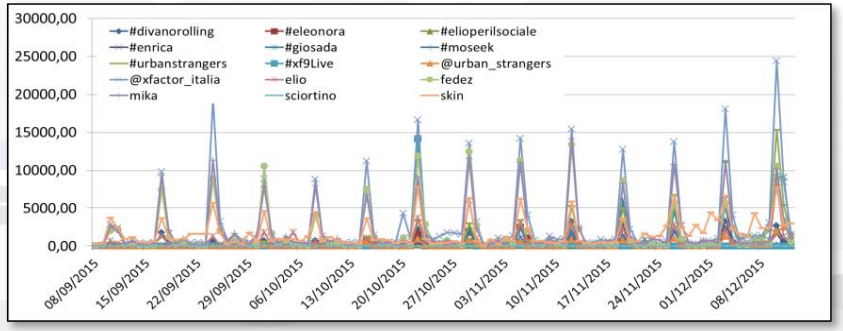


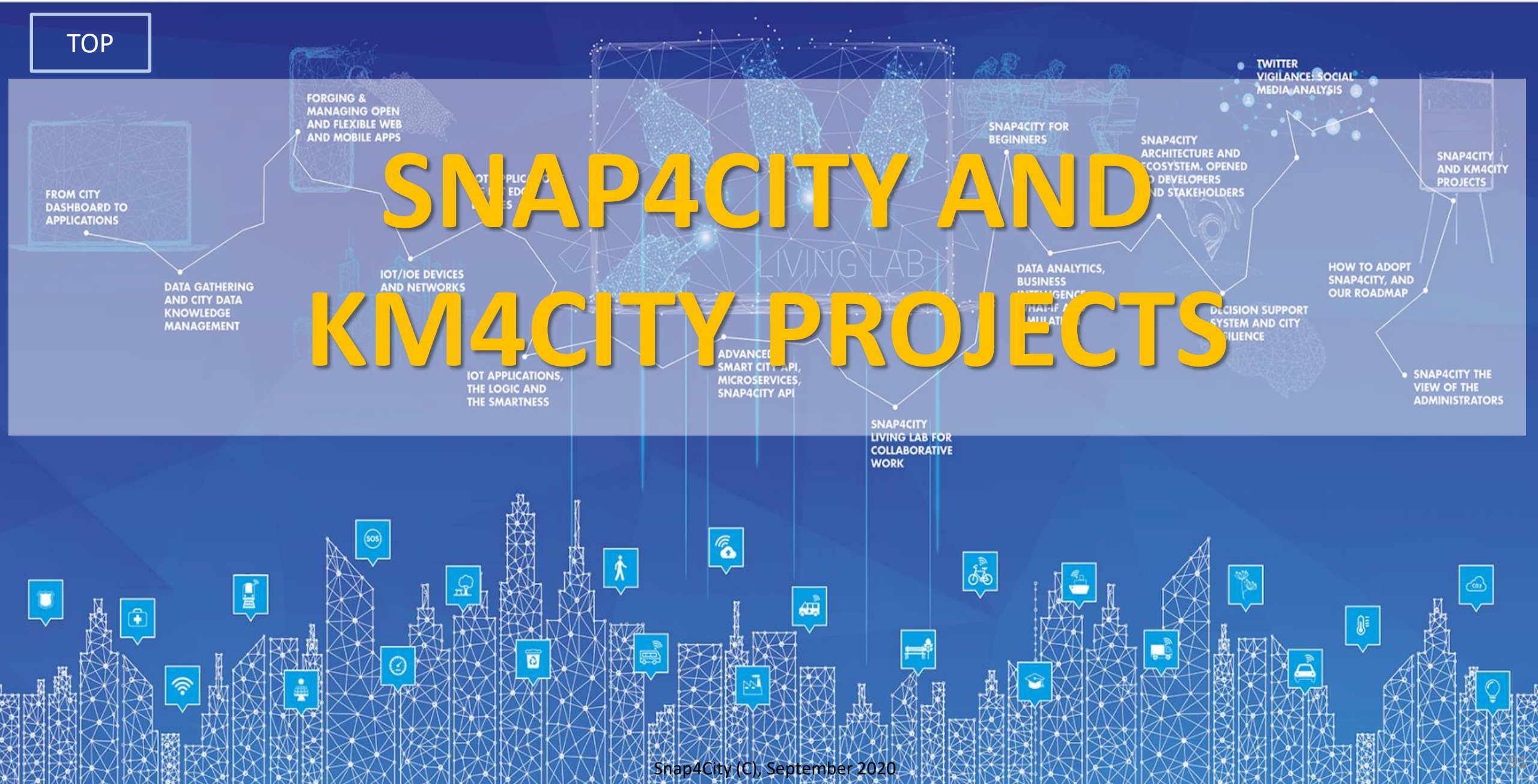
Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.

Attendance at recurrent events: TV, footbal



TOP

SNAP4CITY AND KM4CITY PROJECTS



DISIT lab roadmap vs model and tools' usage

2013
Km4City Ontology 1.1

- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph

2014
- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.4

2015
Km4City 1.5

- Resilience Decision Support
- Smart First Aid
- User Behaviour Analysis, predictions
- Risk Analysis

ckan, resolute

H2020 (2015-18)

2016
(2016-21) H2020 REPLICATE

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.6.2

Sii-Mobility (2016-21) MIUR

SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

FIWARE

2017
Km4City 1.6.4

Sii-Mobility

- Origin-Destination and trajectories
- Traffic Reconstruction
- Offer Analysis
- OBU, smart devices

E0l5 digital ecosystem (Powered by EXPO MILANO 2015)

(2016-19) MIUR GHOST SIR

- Sardinia Region Smart City Strategies and plan

GREEN IMPACT C.A.P.A.C.I.T.Y.

GREEN IMPACT
POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

- IOT/IOE, IOT App
- Living Lab
- Maker Support
- IOT Edge
- Smart City IOT
- GDPR,
- Privacy & Security

life weee (2017-20)

- Smart Waste

2018
MOSAiC MObility 4.0 for SmArt (i) CiTy (2018-20)

- Mobility Demand / Offer Analytics and Strategy

Sii-Mobility

- User engagement
- Bike Sharing
- Data Analytics ++
- Social Predictions
- OBD2

IOT/IOE

Km4City 1.6.6

Node-RED

SNAP4CITY SELECT for Cities H2020 (2017-19)

2019
5G (2018-21)

- 5G tech
- Energy
- Industry 4.0
- Synoptics

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

EUROPEAN OPEN SCIENCE CLOUD

SIRIUS

LAID Smart Bed

- Smart Health

GREEN FIELD PEAS Soda4.0 (Optimization and Automated Decision System 4.0)

- Industry 4.0

bee smart city

- Smart Lonato

Reverberi Enetec Gruppo MPES

- PCP Award

SELECT for Cities 1° place award to SNAP4CITY

2020
- Smart Tourism
- 6 Pilots
- Data Analytics
- Extended platform

2021
- CAPELON
- Sweden

smartGARDAlake

Interreg MARITTIMO-IT FR-MARITIME MOBI MART

- Smart Mobility
- PISA, PUMS
- Living lab

Interreg Mediterranean HERIT-DATA

…2022

https://www.snap4city.org/577

On Line Training Material (free of charge)

	1st part (*)	2nd part (*)	3rd part (*)	4th part (*)	5th part (*)	6th part (*)	7th part (*)
what	General	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App
PDF							
Inter active							
Video1							
Video2							
Video3							
Video4				none		none	none
duration	2:55	3:16	3:41	2:00	2:48	2:35	1:47

TOP

SNAP4CITY

KM 4 CITY

Be smart in a SNAP!

SNAP4
Appliances and Dockers
Installations

CONTACT

DISIT Lab, DINFO: Department of Information Engineering
Università degli Studi di Firenze - School of Engineering

Via S. Marta, 3 - 50139 Firenze, ITALY
https://www.disit.org

www.snap4city.org

Email: snap4city@disit.org

Office: +39-055-2758-515 / 517
Cell: +39-335-566-86-74
Fax.: +39-055-2758570

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